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Advanced Aid for Visually Impaired for Reading Text Online

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Abstract*— The tremendous growth in technology in today's world has made it feasible to provide the visually impaired with means that enable them to use the computer and all associated technologies like the internet for the same functions as others do. The Human Computer Interaction (HCI) aspects involved in making a computing device available to a visually impaired person differ largely from that for a normal person using a computer. This paper provides detailed information about a developed application which would enable and facilitate the visually impaired in connecting to the e-world. Our paper is an advanced and extensive description of this application that allows them to read websites online through the conversion of text to Braille language. This application has a special feature of voice commands through which user can give input in the form of speech as well as obtain the output in the form of speech. A previous paper on the same is the technical description of the previously developed system. This paper is a proposed and advanced model of the developed system highlighting its flaws and deficiencies and suggesting comprehensive changes and how to implement the same in the application design and construction of the original application.

***Index Terms*—Braille, Computer Applications, Human Computer Interaction, Voice Commands.**

I. INTRODUCTION

Use of the internet for learning has become an essential and effective educational tool in the 21st century. The World Wide Web has become increasingly easily accessible for learners to acquire information and knowledge in various forms like text, graphic, numeric and animation and on a wide variety of subjects for their learning and understanding. With the high processing speeds available due to the advents in technology and the reach and extent it has, the internet has become a necessity for education universally.

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But the visually impaired learners who actually represent a substantial proportion of the world's population have little or no access at all to this tool nor is it feasible to make them self-sufficient in using the internet through normal methods of Human Computer Interaction. Seeing how essential it is to use a computer for education, there is a need to develop and propagate computer-interaction devices for the visually impaired as they too have an equal right to education and knowledge.

Reading by the visually impaired is done using Braille language which is a system of notches on a surface for a range of characters. The system developed uses the same Braille code for reading text written on a computer. The existing systems for this are the ones that only allow text printing using advanced keyboards and printers. But systems for interpreting text on a computer online are still yet to be developed completely.

We present here a software application that uses the same Braille code to enable users to read what is written on a computer. As part of the application, we build a special portable Braille Hardware and interface it with the developed software on a computer along with built in audio interface to read through text characters and provide the corresponding impulses of the code for each character in Braille language on the hardware. By feeling the hardware with the palm of one's hand it is possible for the visually impaired to identify the characters and thereby read the online text.

In addition to reading plain text written on a computer, the software also provides means for interpreting the text on web pages by removing unwanted multimedia content like ads, images and only making available the text that is relevant to the information required by the user. Text from word-processing systems, files can also be interfaced and read using the application.

However when actually surveyed with the visually impaired community, it was found that the system is slow as it allows the reader to read only one character at a time while visually impaired persons are far more adept and skilled at reading Braille than the system requires. Hence, a few changes and modifications in the design, coding and implementation of the existing system allowed us to come up with plans of an advanced dynamic and revolutionary system that will ease out the flaws of the earlier system and hopefully serve to provide the visually impaired with tremendous help in reading data from computers and the internet.

II. EXISTING SYSTEM

The previously existing system used by the visually impaired to read text on a computer is a Braille embosser. A Braille embosser is a special impact printer, which prints text in the form of tactile Braille cells.

Braille embossers are expensive and larger than normal printers and are not portable. In addition, Braille embosser uses special Braille paper which is thicker and more expensive than normal paper. Only a few high-end embossers are capable of printing on normal paper.

Thus, this system is not eco-friendly and involves usage of a large quantity of paper. The need to develop a paperless, cheaper and portable system was the motivation behind our application.

III. DEVELOPED SYSTEM

In our system we created a text reader for the visually impaired using a software interface to read through text characters and provide the corresponding impulses of the code for each character in Braille language. For every such character, the software code is generated which converts the character into signalled impulses. These impulses are supplied to a tactile hardware using which the user can interpret the code for each character and identify the character one by one and thereby succeed in reading the text on the computer. The speed in which the characters were translated onto the Braille hardware could be set by the user as per his convenience using a track bar button or the assigned voice commands.

As a large number of visually impaired users are also known to be having hearing difficulties, the output through the specially designed Braille hardware was an important development.

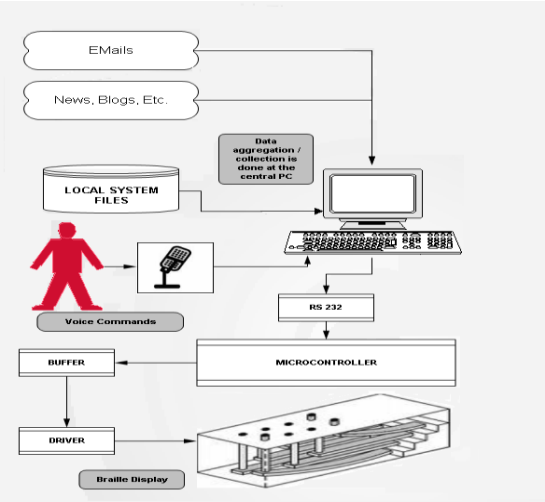

Fig 1.Overall block diagram of the project

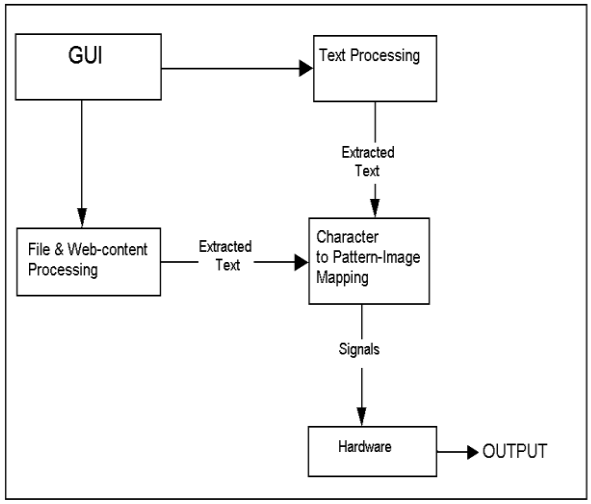

Fig 2.Module Interaction Diagram

The application was developed using C# .NET technology that allowed us to create the front end or Graphical User Interface of the system. A variety of features incorporating speech synthesis and recognition, text processing, web-content processing, importing and reading of documents files were included in this application.

Figure.2 shows the different modules of our application and how they are combined together into the software.

IV. DESCRIPTION OF DEVELOPED SYSTEM

In order to facilitate the construction of the application, the system was divided into following developmental modules:

A. Graphical User Interface Development.
B. Text Processing & Reading.
C. Reading Text from File and Web-Content.
D. Character to Pattern-Image Conversion.
E. Hardware Implementation.
F. Hardware Interfacing & Mapping with Software.
G. Audio Interface Incorporation.

A. Graphical User Interface Development

The Graphical User Interface developed using C#.Net programming, consisted of a user-friendly and modern front-end along with in-built audio aids. This was developed in accordance with the requirements which included text reading & processing, file importing and processing and reading web content and processing it. The GUI developed was basically a collection of application forms with buttons and tools that could be used for performing different tasks such as text, file and web content reading as per the users' choice.

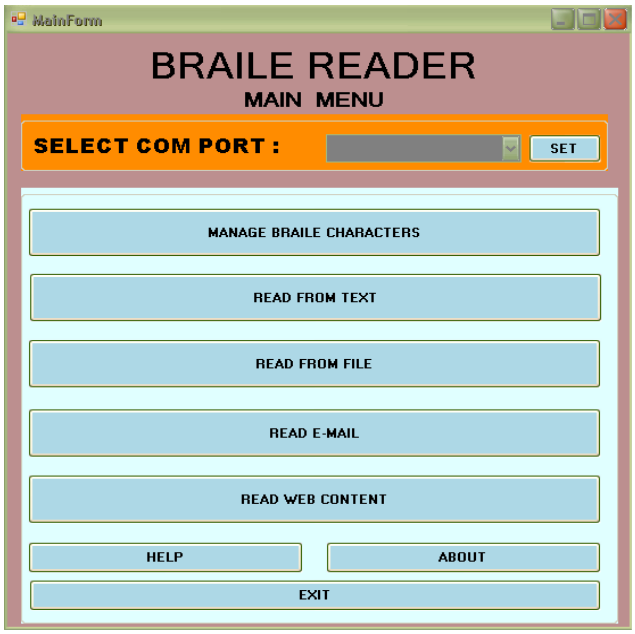

Fig 3.Main Page

B. Text Processing & Reading

The text processing feature helps in reading of text data entered in a text box present in the text reader section of the Graphical User Interface. The text can be entered directly by typing or by copying and pasting into the window.

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In this initial phase the text can be read through the hardware and the output will also be the audio of the text entered.

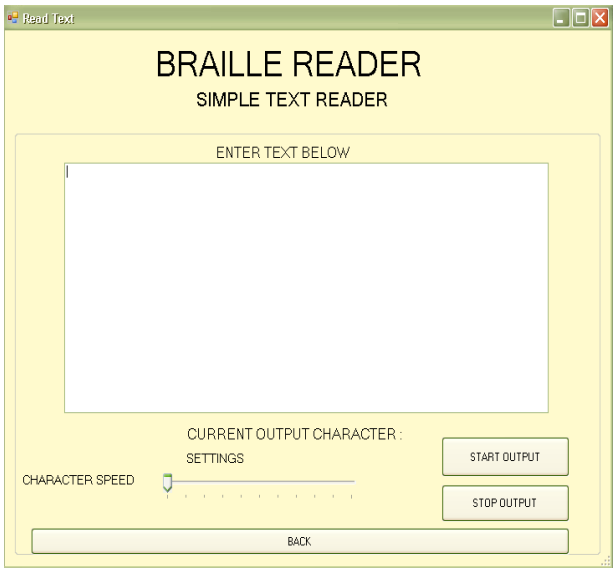

Fig 4.Simple Text Reader

Fig.4 shows the text processing form where the text entered in the text box will be taken as input on pressing the Start Output button and its output will be generated on the hardware.

C. *Reading Text from File and Web-Content*

The file import feature allows the user to import any file into the application. This file is processed and the text from it is extracted leaving out the images and other such multimedia content. The web-content-reading feature allows reading content from web pages by only extracting the text on the web page. The text extracted in the above cases is supplied to the character conversion stage.

Fig.5 shows the web content reader box that enables reading of text from web pages through RSS feeds.

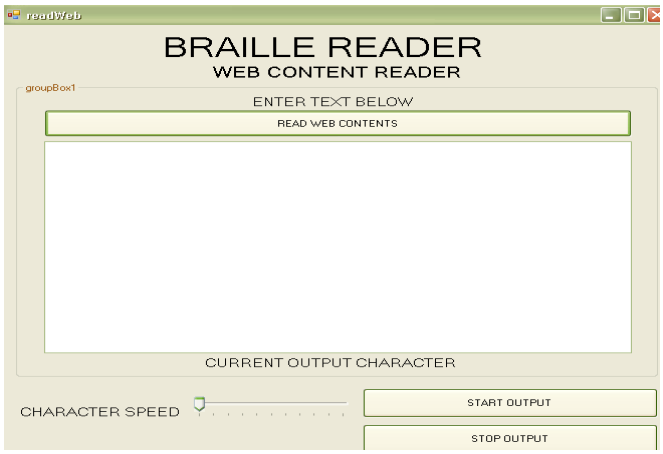

Fig 5.Web Content Reader

D. *Character to Pattern-Image Conversion*

A set of individual pattern-images are generated for a number of characters (as per the Braille code of the characters) and stored. The text extracted from the above module is processed character-wise here. Each character that is being read is mapped into its corresponding pattern-image that is stored in the memory beforehand. Then depending upon the pattern of the specific character the respective signals are sent to the hardware through the microcontroller.

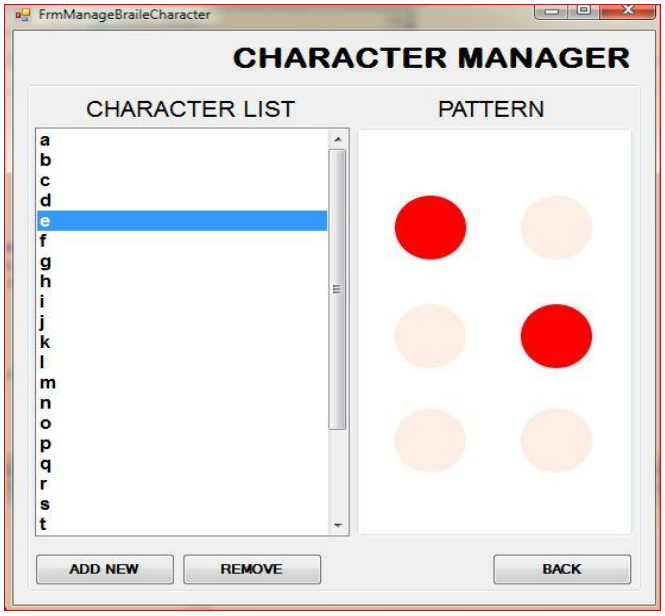

Fig 6.Character to Pattern Image Conversion

E. *Hardware Implementation*

This module consisted of development of the actual hardware. This hardware enables reading of the pattern-images from the above module using a hardware circuit and Solenoid pins. Apart from building the circuit using electronic components, this phase involves mounting of micro-controller and burning the code into the micro-controller. The hardware also consists of a user end, where the user reads the input text character by character and depending upon the character, the corresponding pins are raised. Their movement can be detected by fingers placed on them and individual characters can be identified and the text read collectively.

The Braille hardware was made up of a box chassis with six solenoid pins in it. Each pin was connected to a coil and would be pulled down when current passed through the coil.

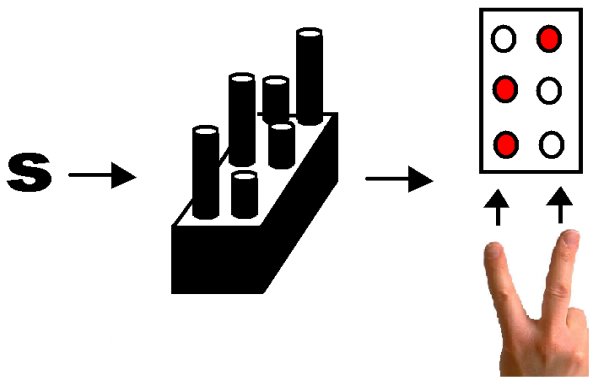

Fig 7.Hardware Design

Fig.7 shows the design of the hardware that was be used for reading the character by placing the palm of the hand or two fingers (whichever convenient) on the hardware and feel the rise and fall of the pins. By identifying the pattern and with prior knowledge of the Braille code for alphabet “s”, it could be read.

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4.1 Hardware Interfacing & Mapping with Software

The hardware developed is connected to the computer through cables using DB9 connector that is plugged into an RS 232 port. The software application developed and hardware can be interfaced with the hardware and the pattern-images generated from the characters are supplied to the hardware in the form of electrical impulses or signals. The hardware processes these signals and effects the corresponding pins on the hardware. Fingers placed on these pins enable recognition of the character and successive reading of text.

4.2 Audio Interface Incorporation

The application when finally completed is with Microsoft Speech Application Programming Interface(SAPI) .This Interface allows the user to navigate through the application and perform his desired operations entirely using voice commands like Back, Read , Volume, News, etc .Voice commands are added to help the user in being self sufficient in using the application. In addition, the text on the file or web page is also converted to audio and available for listening.

V. DRAWBACKS OF THE DEVELOPED SYSTEM

When actually surveyed with visually impaired persons, the developed application was found to allow the user to read only one character at a time. However fast the speed of translation, our system was not made to cope with the abilities of people who were well-versed in reading Braille and reading one character at a time was cumbersome to them.

In order to overcome the above major difficulty and facilitate reading of multiple characters simultaneously, a new proposed design was made where the size of each individual model hardware is reduced and they are used in connection to read multiple characters at a time.

VI. PROPOSED SYSTEM DESIGN

The proposed system for this uses the same software and audio interface .However, there will be changes made to the hardware. Instead of using a single Braille hardware box to read one character at a time, a design plan was developed to read multiple characters at a time by reducing the size of the Braille hardware and scaling it down to the size where one finger can allow us to identify one character. This scaled down hardware is a node and a collection of nodes can be serialized to obtain the required output. Thus, the proposed system may contain four to eight miniature Braille hardware (depending on whether the user wants to use one hand or both hands for reading) connected in a similar manner to the computer as the developed system to allow the users to read multiple characters simultaneously.

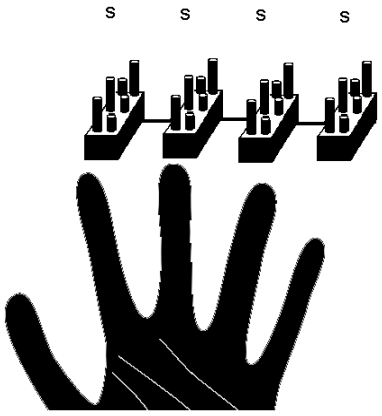

Fig 8.Proposed Hardware Design

Fig.8 shows the design of the hardware that can be used for reading the character by placing four fingers of the hand on the four nodes of the serially connected hardware and feel the rise and fall of the pins on each. By identifying the patterns on each node and with prior knowledge of the Braille code for alphabet “s”, it could be read. The word or term read here will be “ssss”.

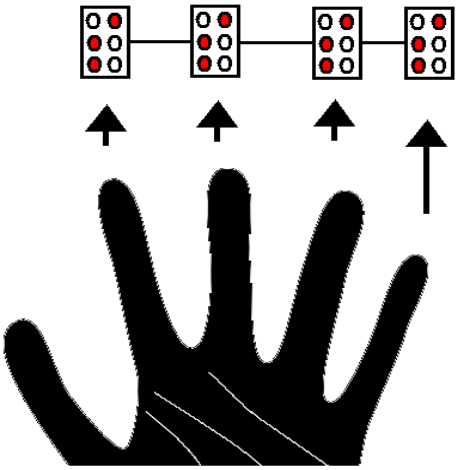

Fig 9.Proposed Hardware Design With Hand Placement

Figure.9 shows the design of the hardware that can be used for reading the character and the hand placement required to read four characters at a time in series.

VII. IMPLEMENTATION

Implementation of the new proposed system can again be done as per the stages in which the original software was developed.

The first few stages will remain the same as the GUI development, Text processing modules will have little or no changes to be implemented. However, as per the new design significant changes will have to be incorporated in hardware construction and hardware to software interfacing.

The hardware has to be downscaled. So for constructing the new hardware the size of the metal chassis needs to be smaller. Inside each chassis the six solenoid pins provided need to wound with wires and signals sent to each of the wires as per the Braille code. Serialization of the nodes on the hardware can be done through coding inside the software

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.This would be a n extension of the serialization coding used for serializing the individual characters on the developed system's hardware .However for the new system serialization will need to be done for the correctness of the character received in the individual hardware nodes and to ensure that successive nodes have successive characters as in the text, file or web page.

As the pattern images for all the characters have been previously assigned.

Synchronisation of the hardware with the software will have to be done using microcontrollers in series, with on microcontroller for each node and serialization within each node .Since there will be four characters being read at a time, coding can be done to ensure that every fifth character is translated back at the first node. In case of hardware with eight nodes (for reading using both hands), every ninth node will have to be translated back onto the first node.At the end, the Audio Interface module can be incorporated as it is.

VIII. CONCLUSION

Thus, the description of a developed system and a visionary design for a new system that incorporate Braille language to produce an application that will facilitate access and use of internet and other computing technologies to the visually impaired are given.

We believe that these developments and designs will prove to establish a bright phase in the lives of the visually impaired as they can now stay in touch with and access modern computing technology as and when they wish.

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