1. Executive Summary

India is home for half of the blind population of the world i.e. 9 million (approx.). The literacy rate is low and for their education books in braille script are not available in adequate numbers. They need to depend on readers for their study and writers for appearing examinations or any other reading or writing work. After finishing their study, they remain dependant on sighted persons for various jobs they undertake in the society. People with Disabilities Act 1995 brought out by Govt. of India focuses on the welfare and protection of the rights of disabled persons so that they are treated similar with a normal person in mainstream activity.

In today’s world multimedia applications are offering many different possibilities of processing audio / video and text at a great speed. This potential can be harnessed suitably for physically challenged people to overcome their shortcoming of any of the faculty due to deformity.

Webel Mediatronics Limited, a Govt. of West Bengal public sector undertaking recognized this immense possibility and regrouped their skills and knowledge to develop and commercialise various products / systems for education, communication and rehabilitation for visually impaired persons. Over a period of time the company developed the following:

Automatic Braille Transcription System in 12 major Indian languages. **Features:**

- Comprehensive System for Braille reading, writing and printing.
- System supports printing through Interpoint Brailler as well.
- Ergonomically suitable for blind users.
- Audio supported six key braille entry.
- Braille knowledge not required for operating the system.
- System supports 12 Indian languages, Bengali, Oriya, Hindi, Assamese, Punjabi, Marathi, Gujarati, Tamil, Telugu, Kannada, Malayalam, Nepali and English.
1.1. System Diagram

1.2. Automatic Braille Transcription System

**Automatic Braille Transcription System** with Text to Braille and Braille to Text conversion and embossing through Automatic Braille Embosser, Index Interpoint Brailler and Brailleo Embosser. The System supports 12 Indian languages namely, Hindi, Bengali, Assamese, Oriya, Nepali, Punjabi, Gujarati, Marathi, Tamil, Telugu, Kannada, Malayalam and English. The transcription system installed at the blind schools are being used for the first time for printing text books, question papers, class notes, notices etc. facilitating a qualitative change in Braille education. Braille to Text Transcription Software can also be used for written communication with the sighted.
1.3. E-Classroom System

**E-Classroom System** consisting of a specially designed Braille Keyboard and a multiuser BrailleWriter software. Using this software 8 visually impaired students will be able to type in Braille simultaneously through 8 Braille Keyboards connected to a single computer. The teacher can see on the screen what each student types. The system provides an interactive electronic classroom facility.

**BrailleExam:** An application for taking Examination of the visually impaired students in a computerized classroom environment.

The above systems in different configuration are already being used in 110 Blind Schools in 22 major states throughout India.

The transcription system installed at the blind schools are being used for the first time for printing text books, question papers, class notes, notices etc. facilitating a qualitative change in Braille education.

Currently the system covers transcription in 12 Indian languages such as Bangla, Hindi, Assamese, Oriya, Marathi, Gujarati, Punjabi, Tamil, Telugu, Kannada, Malayalam, Nepali and English.

Braille-ready texts are being made available in all the above Indian languages at www.braille-aids.com.

1.4. Benefits

Using the above system it takes much less time to learn Braille.
· Students are getting more interest in Braille education as they use computers.
· Using the system a blind school can meet day-to-day demand of Braille locally without being dependent on a remote Braille Press.
· The concepts of e-classroom for the visually impaired are on the way of coming up as a reality.

2. Situation before the Initiative

Having done all this work it was brought to the notice of the company that visually impaired persons are not able to access document from Internet and also to the conference proceedings in Braille and they can not take printout of the selected part of such proceeding in Braille. Text to Speech Systems available do not provide these interfaces for conversion & subsequent reading & taking print in Braille.

3. Strategy Adopted

Having known that Centre for Development of Advance Computing (CDAC), Pune done some useful work in Text to Speech in English, the company started interacting with them for planning a suitable system under guidance of Ministry of Communications and Information Technology, Govt. of India.
After preliminary discussion on the proposed system, it was decided that the software should be developed for visually impaired people being enable to browse the websites through listening.

**Specification:**

This software should first download the web page and then extract all links and text of the web page.

Application should consist of following systems:

I) Extractor: which extracts links as well as text of webpage.

II) Text to Speech System: It should convert text into speech output. It should also consist of following functionalities:
   a. Pausing / Resuming speech.
   b. Stopping speech.
   c. Changing volume of speech.
   d. Changing rate of speech.

III) Text to Braille System: It should convert Text into Braille format and it should be given to Braille Embosser or should be given to Tactile Reader.

The feature of the software should be as follows:

- This software should be least expensive which would provide advantage over the commercially available systems.
- Should browse and access a document from a conference website.
- Should enable browse and listen to content of the Conference websites through Text to Speech system and to read the content through Text to Braille System.
- User should be able to save the documents and convert the same into Braille.
- Should allow to take Braille Print through standard braille embosser.
- Application should provide interface with Webel Mediatronics Limited make Tactile Reader to read the document in braille.
- Friendly interface for visually impaired people. They should be able to easily operate this software.
- Extracts the contents of “.doc” link pages also.

The team shared the proposed concept with eminent visually impaired users and collected their observations and fine tune the specifications of the proposed system upon finalizing the specifications the company got in touch with Center for Development of Advance Computing, Pune an institute under Ministry of Communications & Information Technology, Govt. of India since they have developed a Text to Speech system in English language. The two teams sat together and discussed various matters related to hardware and software and also the user interfaces. A number of times the decisions taken had to be shared with the users and the progress was reviewed and shared with the representatives from Ministry of Communications and Information Technology,
Govt. of India as well.

Having finalised the system layout the two teams went on to discuss the system algorithm and user interfaces, the task was defined and segregated depending on the skill availability and knowledge and application.

Based on the defined of tasks, a schedule was prepared defining the responsibility of each person of two teams and simultaneously a person was made responsible for preparing the user and operation manual. While doing the work several meetings were held with the users at National Association for the Blind, Mumbai, a group of users from Blind Schools in and around Kolkata.

The developed product has been described in the Project Report.

4. Results Achieved / Anticipated

After rigorous work for 3-4 months, the prototype of the system was shown to selected users and subsequently to the then Hon’ble Minister, Ministry of Communications and Information Technology, Govt. of India and Secretary and Additional Secretary, Ministry of Communications and Information Technology, Govt. of India. One system was sent to Ms. Kicki Nordstrom, President, World Blind Union to their office in Stockholm. She said in the World Summit on the Information Society, that she could not read the papers of the conference as they are not available in braille. Honorable Minister in his speech next day in the summit promised that “... ... within 3 months I will personally send you Text to Voice software that will read aloud all the papers the moment they are accessed on the website of the summit”. She expressed satisfaction in a letter written to Ministry of Communications and Information Technology, Govt. of India about performance of the system after 2/3 months. Our system has been kept at Media Lab Asia, Ministry of Communications and Information Technology, Govt. of India for use at various conferences organized by them. Two working systems are available one at Webel Mediatronics Limited, Kolkata and Center for Development of Advance Computing, Pune.

5. Viability and Sustainability

In today’s world we find although visually impaired many persons are joining professional career such as lawyers, chartered accountants, professors, singers, teachers etc., visually impaired persons also showing extraordinary skills in sports and other extra curricular activities specially chess. A blind person recently has conquered Mount Everest, the highest peak of the world. With more and more blind persons completing higher education, their need for browsing Internet and reading text in braille in conferences have become a need of the day. Webel Mediatronics Limited had the proud privilege of supplying conference proceedings in braille for Regional Symposium on Disability in Dhaka in December 2003. Therefore these system has come to stay and will find application more and more in our country. There is no other Text Reading System known to us integrated with paperless reading in Braille and print in Braille.
6. Lessons learned and Documentation

The documentation narrated in the foregoing is appreciated by users since it has been prepared in consultation with eminent blind professionals to make it user friendly.

Webel Mediatronics Limited has already installed Automatic Braille Transcription System at 27 Special Schools for the Blind and two District Libraries in West Bengal. These institutions have already been connected with one another through Internet. Shruti Drishti is being installed in these institutions gradually to enable them accessing documents from Internet and also accessing other text documents.

The company is now taking up similar work in Indian languages and integrating them with the Automatic Braille Transcription System. It has already developed and commercialized in all major Indian languages.

7. Transferability / Replication

Webel Mediatronics Limited being a commercial organization engaged in development (it’s Research and Development wing is recognized by Department of Science and Technology, Govt. of India) of hardware, firmware, software and manufacturing most of the products themselves, do not find any difficulty in replicating the same and meeting the requirement of the country. If at any time it is so required, the technology can be transferred to meet the demand, Webel Mediatronics Limited is not able to handle, technology can be transferred to Media Lab Asia, Ministry of Communications and Information Technology, Govt. of India.

In many applications this system can be used as “add-on”. Recently this system has been installed with SAFA, a text reading software, being developed by National Association for the Blind, New Delhi for extended field trail. Efforts are also being taken to install such systems along with various e-Governance portals / kiosks all over the country.

**COMPUTER AIIDED TTS AND TEXT TO BRAIILLLE SYSTEM FOR THE IISUALLY IMPAIRED (SHRUTII DRIISHTII)**

The result of the developed product is as follows:
The main screen is an HTML Extractor. The upper portion shows web browser which displays the web page. Lower left box contains text extracted from the web page. Lower middle box contains list of all links present on the web page. Lower right pane displays text in braille format.

Link Mode:
Users can enter in link mode by pressing F3 key. As user press F3 key, application reads the first link of the page. User can then listen all the links present on the web page by pressing DOWN and UP arrow keys. Pressing DOWN arrow reads next link and pressing UP arrow reads previous link.

To select a particular link and to go to that URL user has to press ENTER key.

Content Mode:
User can listen text contents of web page by pressing F4 key. Application sends content text of web page to text to speech system as well as to braille tactile reader.

Settings Mode:
User can change the default settings of the application. If users wants to send output to text to speech system or only to braille tactile reader, then he can do it by entering into setting mode. To change the settings user has to press F8
key. After pressing F8 key application will ask for following three options:

2. Change Speech Volume.
3. Change Speech Rate.

These options are presented as speech output.

User can traverse these three options using DOWN and UP arrow keys. To select a particular option user has to press ENTER key.

1) Change Process Mode: Selecting this option will ask for following three options
   a. Process Speech: Text will be given to Text to Speech system only.
   b. Process Tactile Reader: Text will be given to Text to Braille system only.
   c. Process Speech as well as Tactile Reader: Text will be given to both Text to Speech as well as Text to braille System.

User can traverse these three options using DOWN and UP arrow keys. He can select option by pressing ENTER key.

2) Change Speech Volume: User can increase or decrease volume using this option.
   To traverse the options available user can use DOWN and UP arrow keys and to select volume level he has to press ENTER key.

3) Change Speech Rate: Selecting this option will ask for following options:
   a. Normal: To select normal speech rate.
   b. Increase by one: To increase the speech rate by one.
   c. Increase by two: To increase the speech rate by two.
   d. Increase by three: To increase the speech rate by three.
   e. Decrease by one: To decrease the speech rate by one.
   f. Decrease by two: To decrease the speech rate by two.
   g. Decrease by three: To decrease the speech rate by three.

User can traverse these three options using DOWN and UP arrow keys. He can select options by pressing ENTER key.

**Pausing / Resuming Speech:**
User can pause or resume speech by pressing spacebar. If text to speech system is reading any text and user wants to pause speech then he can press spacebar. This will pause the speech. To resume the speech, press spacebar again. Same can be done using F9 key also.

**Stopping Speech:**
User can stop the speech by pressing Control key. Speech will be stopped immediately. Same can be done using F10 key

**Browsing back:**
User can browse previous page visited using combination of ALT key and LEFT arrow key. First press ALT key, hold it down and then press LEFT arrow key. Same can be done using F11 key.

**Browsing Forward:**
User can browse forward page visited using combination of ALT key and RIGHT arrow key. First press ALT key, hold it down and then press RIGHT arrow
key. Same can be done using F12 key.

**Braille Printing:**
First make sure that the printer is on and paper is feed into it. Then to make the printout of the content of web page in braille format, press F5 key. Pressing F5 key will display braille printing form. Then click on “Prepare to Emboss” button. This will do some settings and “Emboss” button enabled. Then click on “Emboss” button to start printing.

**Tactile Settings:**
User can change the settings of Tactile Reader by pressing F6 key. This will display Tactile Reader settings form.

**Display for Partially Blind People:**
Pressing F7 key pops up new window showing text content of web page. This text is displayed in black bold face on dark yellow background. This helps partially blind person to read easily.

**Full Screen:**
It is possible to have full screen view of application. This can be done by pressing F2 key. Pressing F2 key again will set application to normal view. F2 key acts as toggle key.

In case of any problem following points should be taken care of:

1) Checking if CEmbosss.oxx is registered properly.
2) Checking if BrailleView.oxx is registered properly.
3) Checking if Tactile.oxx is registered properly.
4) Checking if Wsound.dll is registered properly.

**List of Commands:**
1) F2 Key : Full Screen
2) F3 Key : Read Links
3) F4 Key : Read Content
4) F5 Key : Print content on braille embosser
5) F6 Key : Tactile Reader Settings
6) F7 Key : Show content for partially impaired
7) F8 Key : Change Settings
8) F9 / Spacebar : Pause / Resume Speech
9) F10 / Control Key : Stop Speech
10) F11 / (ALT+LEFTarrow) : Print content on braille embosser
11) F12 / (ALT+RIGHT arrow) : Print content on braille embosser
12) DOWN Arrow Key : Read Next Options / Link (Traverse options)
13) UP Arrow Key : Read Previous Option / Link (Traverse options)
14) ENTER Arrow Key : Select current option.
The proposed System Diagram will be as follows:

8. **Tactile Device**

Power Adapter:
Input: 160 to 230 V AC at 50 Hz.
Output: 12 V DC, current operating 160 mA (Max 0.9 amp).

Power and Computer Connecting the Tactile Device
9. Specification

- Number of Braille characters per line is 20
- Input:
  - 12 V DC through jack on the rear panel.
  - In Single user mode, Serial communication RS 232 inlet through 9 pin D connector male.
  - DIP switch setting through the windows on Right Hand side panel.
- Output:
  - Braille display of 20 characters of Braille text.
  - Audio through earphone jack on the front panel. (23 mW)
- Green Led for Power indication.
- RX/TX Bicolor Led indication for receiving/ transmitting data.
- Mechanical dimensions:
  - Dimension: 32cm X 15cm X 4cm
  - Weight: 600 gm.

Specification of Power Distributor:
Amidiag Adapter:
- Input : 190V AC to 230V AC at 50 Hz
- Output : 12 V DC, current operating 160 mA (Max 0.9 amp)

Component Check List (Single User Mode)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the components</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tactile device</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Power supply module and cable</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Headphone</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>RS 232 Serial Data Cable (For Connection between Tactile Device &amp; PC)</td>
<td>1</td>
</tr>
</tbody>
</table>

System Scheme (Single User Mode)
Schematic of Tactile Device System (Single User Mode)

Headphone Connection point

General operation

- Initially power supply switch for the SMPS should be kept OFF.
- Input power supply of 230 V AC, 50 Hz is fed to the SMPS, which converts it into 12 V DC. (Range of SMPS input voltages are 160v-230v AC).
- Now make the switch ON so that device can operate.
- After turning ON the switch all the Braille dots are initialized. Check whether all dots are in low position.
- Audio headphone attached through proper jack, can be used for listening audio outputs corresponding to the key pressing.
- Test whether Braille display are coming with pressing start button.
- Now start reading the Braille text with the help of the keyboard on this device. We can also select next line, previous line, start of line, end of line, end of file, etc by pressing the corresponding key.
Keyboard operation

**Introduction**

This tactile device has special function keyboard having twelve functional keys. Each key is associated with certain essential functions. The keys are of membrane type and gives tactile felling with audio feedback. For ease of identification for the visually impaired user these have the identifying characters in Braille embossed on the membrane. All keys pressing are supported by audio output through headphone.

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**Tactile Device Keyboard**

LED indicates the data reception /transmission is in progress.
LED indicates the device is ON and ready for operation.

**Stop**
This command stops the current operation of the device i.e. reading of the current file.

**End of File**
This command indicates the completion of the content of the file.

**Previous Block**
A block is represented by 20 lines scroll so if a person wants to go to the previous 1 block or more then he can immediately jump to that location by pressing these blocks.

**Previous Line**
Whenever the user wants to refer the previous line just before the current line that is in the output then we simply press this key and we can jump to that location.

**Start**
This command starts the device to start the reading of the text from the beginning of the file.
**Start of File**
This command tells the user that the current text has been started and it is displayed on the o/p.

**Next Block**
This command selects the next display after scrolling 10 lines of the Braille text, block saving our time to the great extend. User can change the number of scrolling lines by using BrailleStation Software.

**Next Line**
It points to the next text line that is to be displayed on the output.
F1 Used for the diagnostic purpose at piezo cells.
F2 Used for the diagnostic purpose at piezo cells. F3 Used for the diagnostic purpose at piezo cells. F4 Used for the diagnostic purpose at piezo cells.

**Tactile Settings**
When the application is running in the Blind mode it will auto probe all the tactile devices attached with the computer. Visually impaired user can set various parameters of the tactile devices by pressing Tab keys and hearing audio feedback from the Computer.

The following paragraph describes in details the step by step operations needed to configure the device.

![Tactile Device Parameter Selection Window](image)

**No of Lines Per Block**
The first parameter is No. of lines per block. This value can be changed using the Up and Down arrow keys and the default value is set to ten.

Though there is no hard and fast rule for changing this parameter and it is entirely dependent upon personal preference, a rule of thumb can be set as follows, larger values should be set for large files. The minimum value of this parameter is ten and maximum value that can be set is thirty five.
Select Active Device ID

Tactile Device can be identified by its unique identification number. Using Tab Key User can go to the next option, ie selection of the appropriate tactile by device number. By pressing up and down arrow keys the user can navigate through the list and select the device. The device identification number can be any number between one to nine.

Configure

Pressing the configure button will configure the selected tactile device with the new parametric values.

NB: After configuring the tactile the user need to press the start button of Tactile Devices to begin operation.

Tactile View

Tact View Control is for viewing the Braille Characters the tactile device is currently showing. Tactile device can be uniquely identified by its device number. By pressing up and down arrow keys user will be able to select the appropriate tactile device.

Braille View Window

Up down arrow keys are to be pressed to select the tactile by the device id. Up arrow increments the device id by one and down arrow decrements it by one. For example in the above picture Tact View control is attached with th device id 3. If the tactile with device id is 3 is active then the Braille Characters currently being displayed in the tactile will be visible in the text area of the control.

BLK and LINE field displays Block and Line position of the current Braille Line with respect to the whole Braille file.

10. Automatic Braille Embosser

A cost effective computer interfacable Automatic Braille Embosser, useful for small-distributed local Braille press.
Salient Features PC driven Automatic Braille Embosser.

- Automatic Paper loading, release etc.
- Self-diagnosis at various stages of operation.
- Suitable for effective local presses – e.g. Blind Institution/ NGOs/ Libraries.
- Supports Text-to-Braille, Braille-to-Text software developed by Webel Mediatronics Limited.

Technical Specification

- Mode : Paper loading, Testing and Printing (2 modes)
- Print format : 30 lines/page & 36 (Programmable) Character per line.
  Automatic Left Margin setting
- Line and Paper feed : Stepper Motor driven
- Parallel operation : Up to 4 printers
- Power : 230 V, 50Hz 1ph AC, 200 watts (app)
- Accessories : RS232 Cable Power Cable

Power and Computer Connecting the Automatic Braille Embosser

Operations Connecting to PC
- Insert the D Connector (M) of RS 232 Cable into the D Connector (F) of Automatic Braille Embosser marked “Computer” on it’s right side (as in Fig. 1).
- Insert the other end D Connector (F) of the RS 232 Cable into serial port on the back of a PC.

Power
Insert the power cable into the power socket of the Automatic Braille Embosser.

- Insert the power plug into the power connection board.
- Input should be 230 V, 50Hz AC.
- Switch on the power by pressing the On/Off switch on the Automatic Braille Embosser.
- Indicators of the paper setting buttons on the side of the Automatic Braille Embosser glow up when power is on.

**Loading Paper**

Locking Paper to the Automatic Braille Embosser
Paper Loading and Unloading button of the Automatic Braille Embosser

Open the Paper Locking System by driving the Locking handles away from you as shown in Fig 5.

- Insert the Paper up to the point where the paper head gets stuck.
- Lock the Paper by pulling the locking handles towards you.
- Now press the paper Loading Button (the lower one on side of the Automatic Braille Embosser as shown in Fig. 6).
- The paper gets loaded.

Unloading Paper

- Press the Unloading Button (the upper one on side of the Automatic Braille Embosser as shown in Fig. 6). Paper will come out a little.
- To take out paper completely press and hold the button.