**BrailleMath**

Nemeth code to print-math back translator

# User Manual

# Interoperate, Inc.
# http://www.interoperate.biz

**Copyright © 2002-2013**

# Overview of *BrailleMath*

*BrailleMath* is **a software** package that helps teachers **teach** mathematics to blind students. This package is developed using image processing and special language translation techniques. The prime use of this software is to help **sighted** teachers **teach** mathematics to blind students. In just a few easy steps, the teacher can convert a Braille page typed by a blind student **into "Print Form," readable by sighted people**, thereby saving a lot of time for the teacher.

## Salient Features of the product:

- Takes as input, a scanned copy of the Braille sheet hand typed on a Perkins Brailler **and outputs a PDF file**.
- *BrailleMath* can handle slanted typed lines as well as irregularly typed lines.
- Documents can contain Nemeth Code and Literary Braille. Nemeth Code expressions are automatically separated from contracted Braille text.
- *BrailleMath* also handles spatial math:
  - Determinants
  - Matrices
  - Grade school,
    - Addition
    - Subtraction
    - Multiplication
    - Long Division, etc.
- Nemeth Code Syntax errors made by the student are detected and confined to the smallest possible area and rest of the document translated correctly.
- User has full control at every step and can change/modify the document in any of the intermediate steps.
- User has the choice of either doing step by step conversion or doing direct conversion to pdf.

## Table of Contents

## 1 Hardware requirements

Memory: 128MB. (256MB recommended)
CPU: Pentium III or faster
Scanner: 300DPI resolution (recommended) or more
Printer: Inkjet or Laser (recommended)

## 2 Software requirements

→ Operating System: Windows XP (All variants) or higher
→ Adobe Acrobat Reader (User needs to install this)
→ MiKTeX (MiKTeX installer is part of *BrailleMath* package. Needs to be installed).
→ Aspell (Aspell installer is part of *BrailleMath* package. Needs to be installed).
→ Aspell Dictionary (Dictionary installer is part of *BrailleMath* package. Needs to be installed).
→ Braille Fonts. (Need to copy Braille Fonts from Installer folder\Braille_Font to "C:\Windows\Fonts" on your machine).

## 3 Installing *BrailleMath*

→ Download the BrailleMath software from
http://www.interoperate.biz/braillemath_purchase.php
→ Install 'Aspell' from the folder.
→ Install "Aspell Dictionary" from the folder.
→ Install 'Miktex' from the folder.
→ Copy Braille Fonts from <Installer folder>\Braille_Font to "C:\Windows\Fonts" on your machine.
→ Add "C:\Program Files\Aspell\bin" to your windows path
→ Now run the setup for BrailleMath; follow the instructions of the installer.
→ The installer will help you navigate throughout your installation process.
→ When installation is finished you can see BrailleMath shortcut on your desktop.
→ The folder "C:\Program Files\Interoperate.biz\BrailleMath" will be created where all the executables and supporting resources are copied.

## 4 Using *BrailleMath*

### 4.1 Scanning the Braille Page

→ Scan the back side of the Braille page to avoid ink marks, if any, on the front side of the Braille page. Scanning should be done at 300 DPI resolution. (A sample image with staple marks and ink marks is shown in APPENDIX figure – A1)
Front side of the image can also be scanned but then ink marks or other marks, if any, should be manually removed from the image (step 4.2).

→ Save the scanned Braille page on your computer in JPEG Format.
→ Proceed to Next Step. (4.2).
→ ***In case of a clean Braille sheet, you can move on to step 4.3.***

## 4.2    Edit the Braille Page using MS Paint

→ Open MS Paint.
→ Open the JPEG image that you saved in previous step. (4.1)
→ Flip the image horizontally/vertically depending on how the image is scanned.
→ Delete staple marks & ink marks on the image, if any, ***using MS Paint eraser.***
→ To delete, you can select any area on the image that does not contain blobs and copy-paste it over the area from where marks are to be deleted.
→ Save the image.
→ Proceed to Next Step. (4.3)

## 4.3    Loading the Braille Page

→ Open *BrailleMath*. You will see a blank window as shown in figure 1.
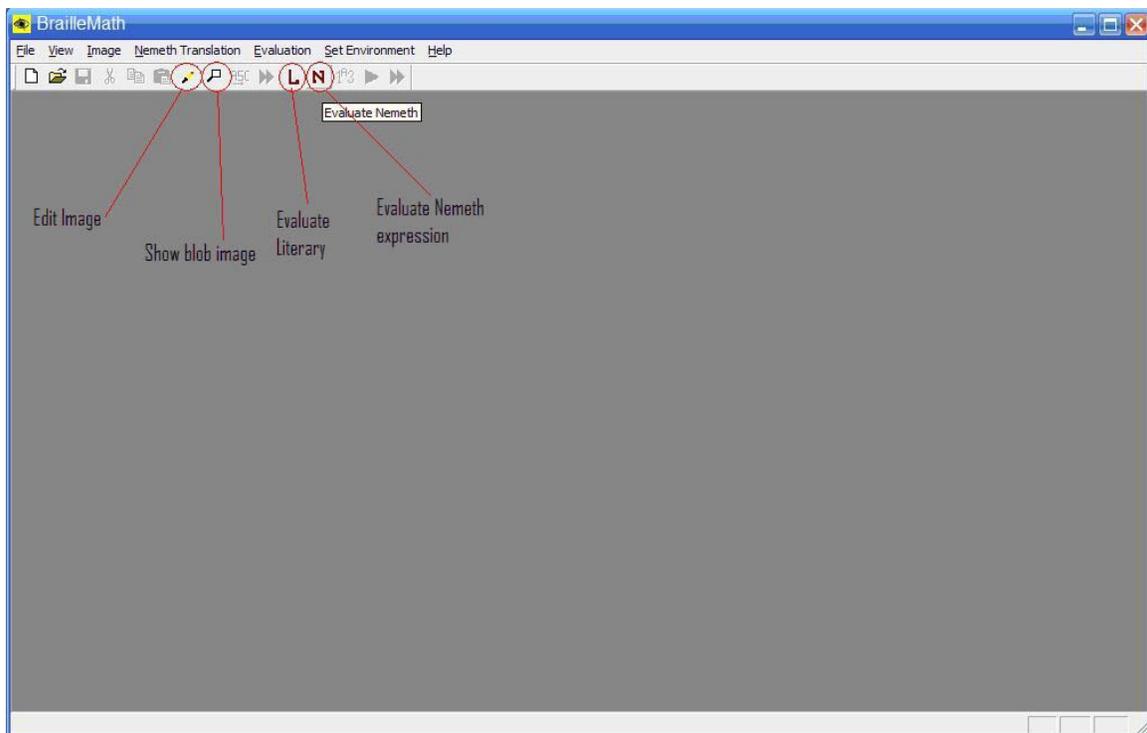


Figure – 1

→ Click on File > Open. You will see a dialog box as shown in figure 2.
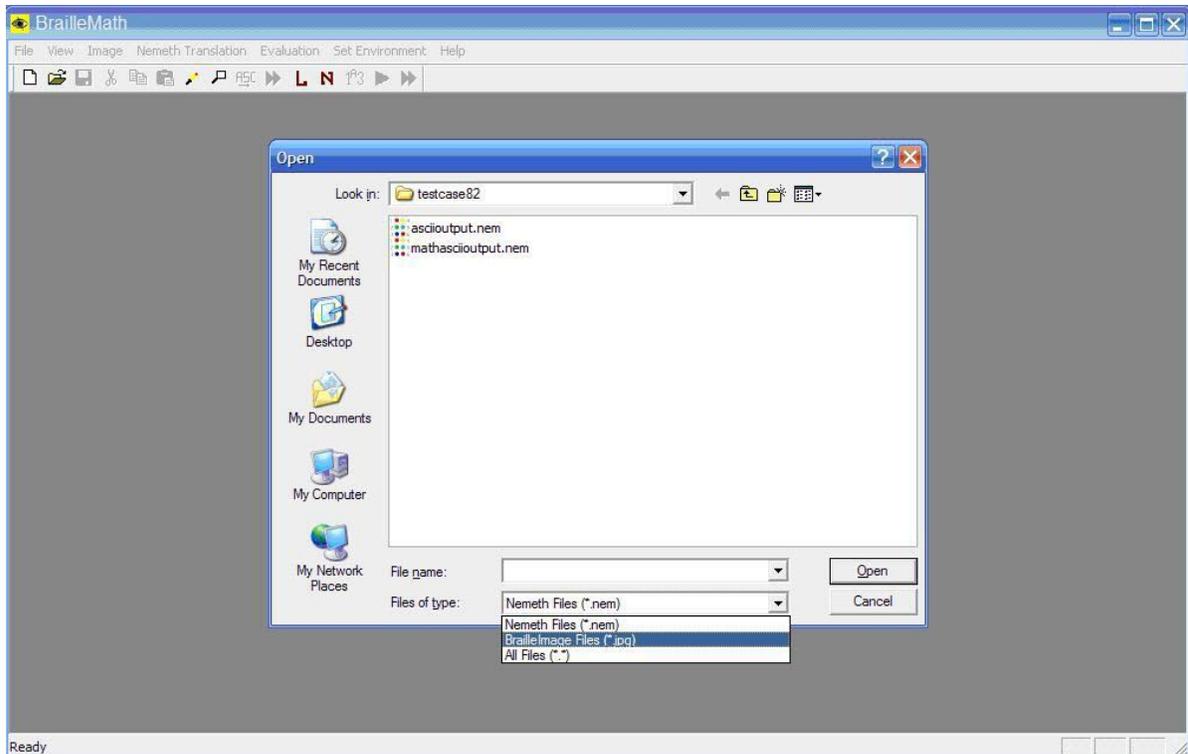
Figure – 2

→ Select "BrailleImage Files (*.jpg)" from the "Files of type" drop down box.
→ Select the JPEG file saved in step 4.2.
→ Click Open.
→ The Braille image loads into the window. The window will appear as shown in figure-3.
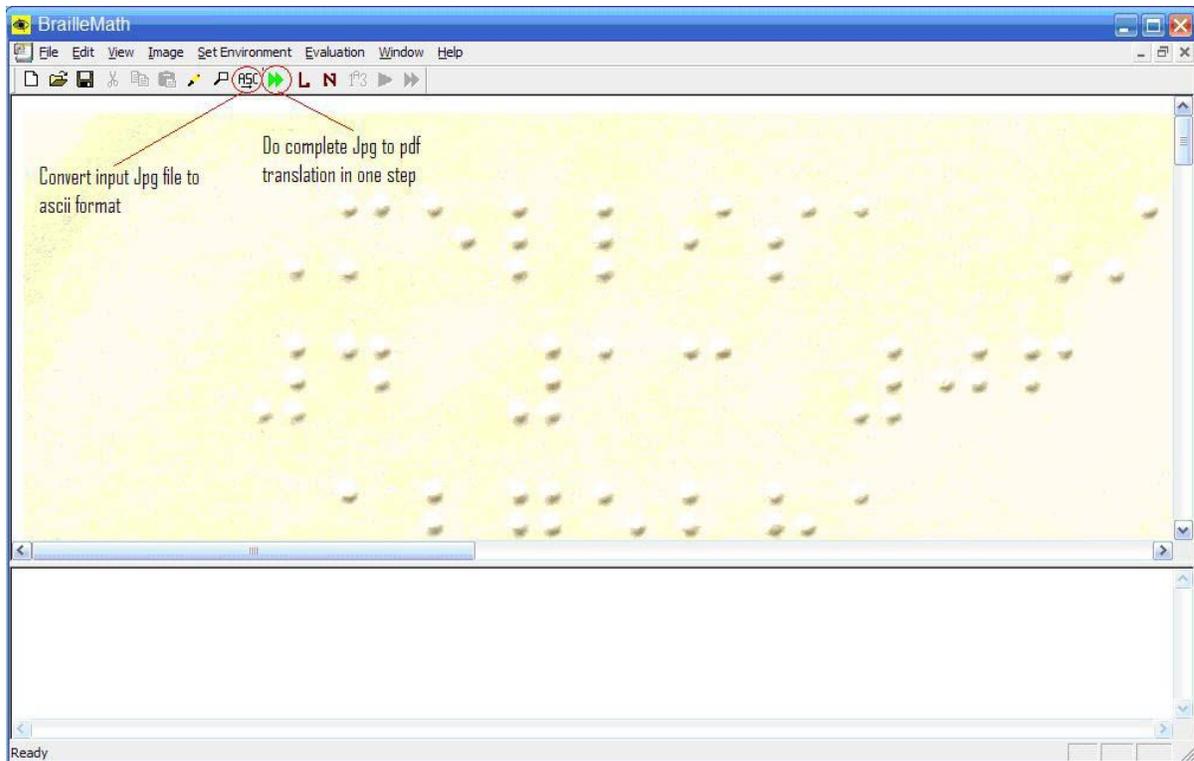
Figure -3

## 4.4 Converting into ASCII

→ At this point there are two options: *direct conversion* or *step by step conversion*.

→ **DIRECT CONVERSION:** To perform *direct conversion*, click on the double green arrow shortcut button on the tool bar (highlighted in Figure-3) or select menu *"Image > Convert to pdf".* BrailleMath will carry out all the intermediate steps without your intervention and will display the final pdf file. Intermediate files that are generated will also be displayed. Be patient, as performing all the intermediate steps may take a few minutes.

Note: If a black window labeled "C:\WINDOWS\system32\cmd.exe" appears that seems to be paused for a response from you, then press "Enter" repeatedly until the window disappears.

→ **STEP BY STEP CONVERSION:** In *step by step* conversion, select menu *"Image > Convert to ASCII"* or use the shortcut button on the toolbar *as shown in Figure 3.*

→ A warning message will be displayed. Click OK.

→ If the system is uncertain about a certain line, *sometimes* it may ask you if the blob (or Braille dot) on a particular line belongs to left column or right column.

→ Verify the same with the original hardcopy Braille page and select either "LEFT_COLUMN" or "RIGHT_COLUMN"

→ Press OK. (The dialog box is shown in figure 4 below.)
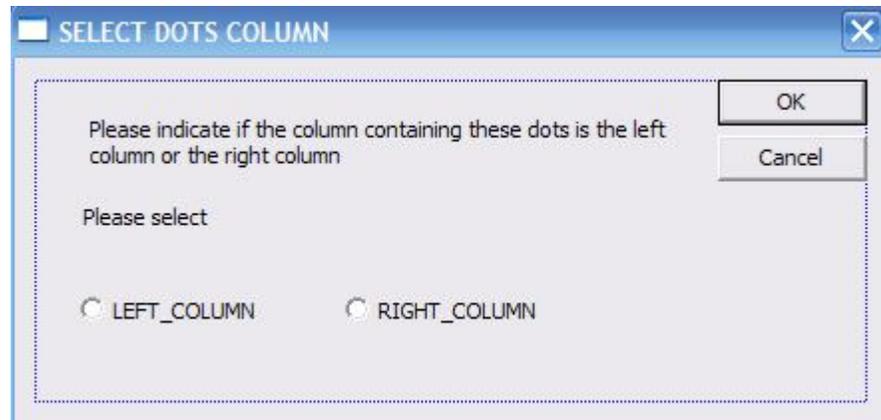
Figure – 4

→ By following the above steps, optical Braille recognition is performed by BrailleMath,        and the Braille characters converted into corresponding ASCII characters.
→ ASCII file is opened in the document view as shown in Figure 5
→ For further translation  proceed to next step (4.5)
→ Otherwise, to avoid going through intermediate steps manually, select the option to convert input JPG file directly to PDF print format by selecting from the menu: "Image > Convert To PDF" or using the shortcut button on the toolbar.
→ BrailleMath will internally perform all the intermediate stages and display the final output in PDF format.

## 4.5    Separating Math

→ The window with the ASCII file will look like as shown in figure 5 below.
→ At this point the user can edit the ASCII file either directly in the screen shown in Figure 5, or through a Blob Editor (see later). This editing may be needed to fix minor errors since optical Braille recognition is not always perfect.
→ To convert further, there are two options given to user. These two options are
   1. *Stepwise Conversion*
        A.  Identification of Nemeth Math and contracted Braille, followed by
        B.  Translating delimited ASCII file to print math and text (PDF).
   2. *Do complete conversion in one step*. Here, user need not bother about identification of math. Identification is done in a manner transparent to the user.
→ **For complete conversion in one step**, select 'Nemeth Translation > Convert ASCII to   PDF' BrailleMath internally does the math separation, generates the Latex file, converts      it into PDF print format and displays it in the "acrobat reader". User can proceed to        next step (4.7).
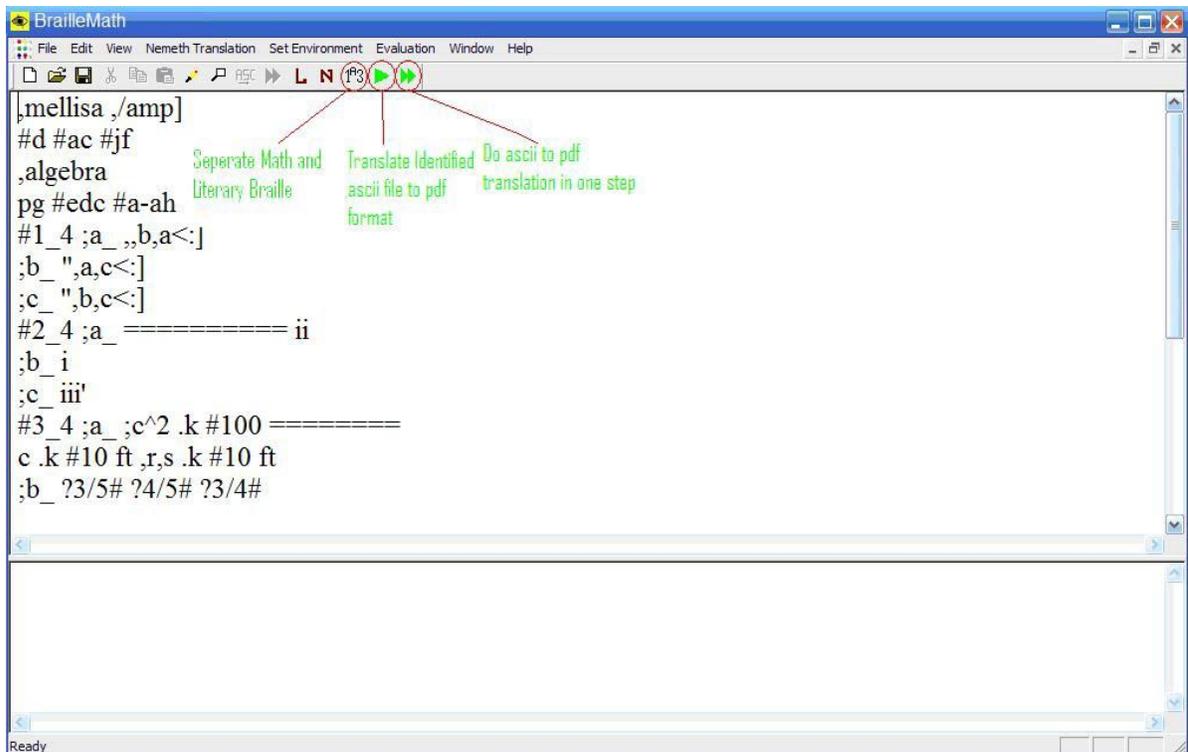
Figure – 5

→ **Step-wise conversion** may have to be performed because automatic separation of Math and text may not be perfect due to mistakes made by a student while typing Braille or due to errors in the optical Braille recognition step. The user can fix Math identification errors by doing step wise conversion as follows:

→ Select "Nemeth Translation → Separate Math" from the Menu or select corresponding button on toolbar as shown in figure-5. BrailleMath will enclose all Math expressions within ;; and ;' tags. These tags can be made more visible by selecting "Nemeth Translation > Show Math Tag" which will display ;; as <MATH> and ;' as </MATH>.

→ These Math Tags resemble HTML Tags. User can manually remove the <MATH> and </MATH> tags if the system wrongly identifies some text as Math. Also, user can insert    the <MATH> and </MATH> tags around expressions that are not identified as Math.

→ Double click the left mouse button to insert <MATH> and double click the right mouse button to insert </MATH> after placing the cursor at the desired place.

→ Once the desired changes are made to the Nemeth File, click on the "save" icon on the toolbar to save the file.

→ Proceed to next step. (4.6)

## 4.6    Converting to LaTeX

→ Click on the "Nemeth Translation > Convert separated ASCII to Latex" from the Menu  or corresponding button on toolbar as *shown* in figure-5

→ Once the conversion is completed, a dialog box will popup asking if you would like to view the Latex file.

→ Click "Yes" to view the latex file; "No" if you do not wish to view the Latex file.

→ After your selection, the latex document will be converted to a PDF document and is saved in the same folder as your Braille Image.

→ Click 'Yes" in the dialog box that appears, to view the PDF output.

→ Proceed to Next Step. (4.7).

## 4.7    Printing PDF Document

→ Now that you have viewed the PDF document, you may wish to print the document by clicking "File > Print" from the Menu.

## 4.8    Other Features of BrailleMath
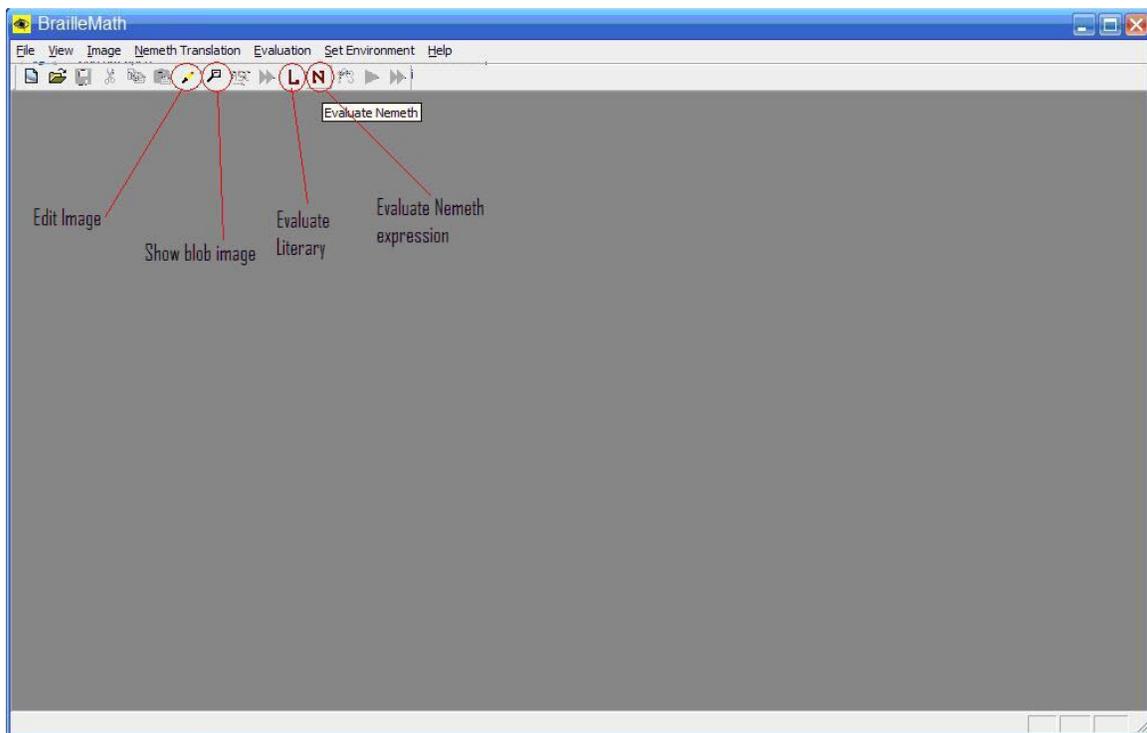


Figure - 6

1. **_Edit Image_** :  This feature opens jpg image in MS Paint and allows user to edit the image . To use this feature, select "Image > Edit image" or select corresponding button on the toolbar as shown in the figure - 6. **_Using MS Paint eraser user can edit a JPG image. User can also darken the dots, if they were scanned improperly. After editing the image, REMEMBER TO SAVE THE FILE._**
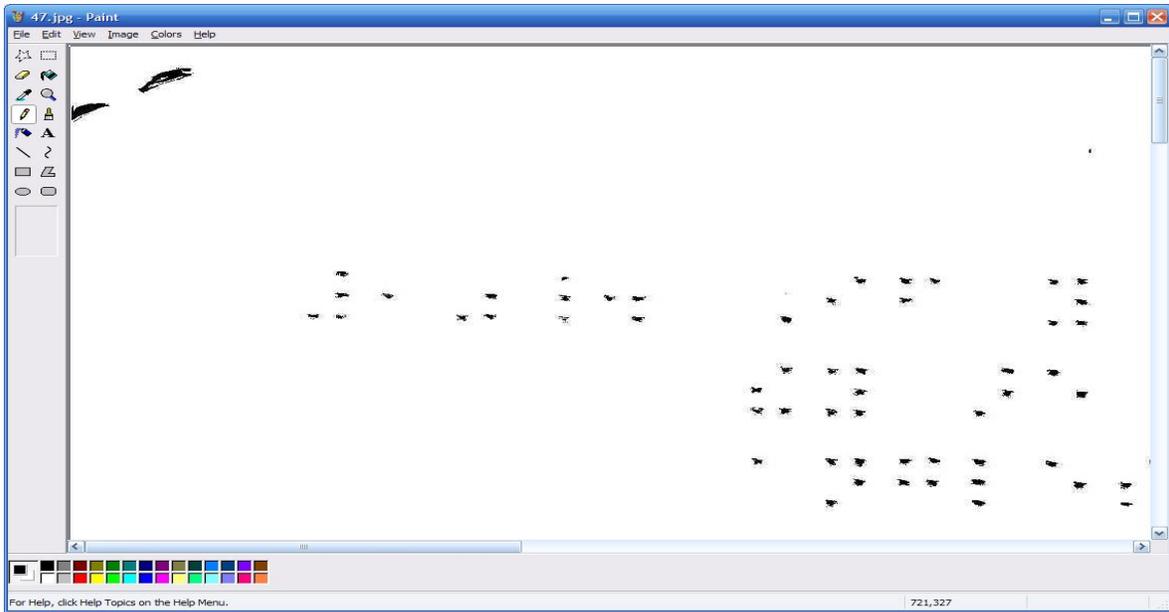
Figure – 7

2. **_Show Blob Image_** : This feature shows the blob image to a user. This is very helpful feature in scenarios where input image is not very bright and BrailleMath has difficulty in recognizing the dots.  To use this feature , select "Image > Show blob image" from menu or select corresponding **_button on the_** toolbar as shown in the figure 6. Blob image will **_appear_** as shown in figure-8. A dot that is not surrounded by a rectangle has not been recognized by BrailleMath. At this point you can edit the JPG image of the Braille Sheet to darken that particular dot using MS Paint, or you can use the _Blob Editor_, described next. The Blob Image displayed (figure 8) itself cannot be directly edited.
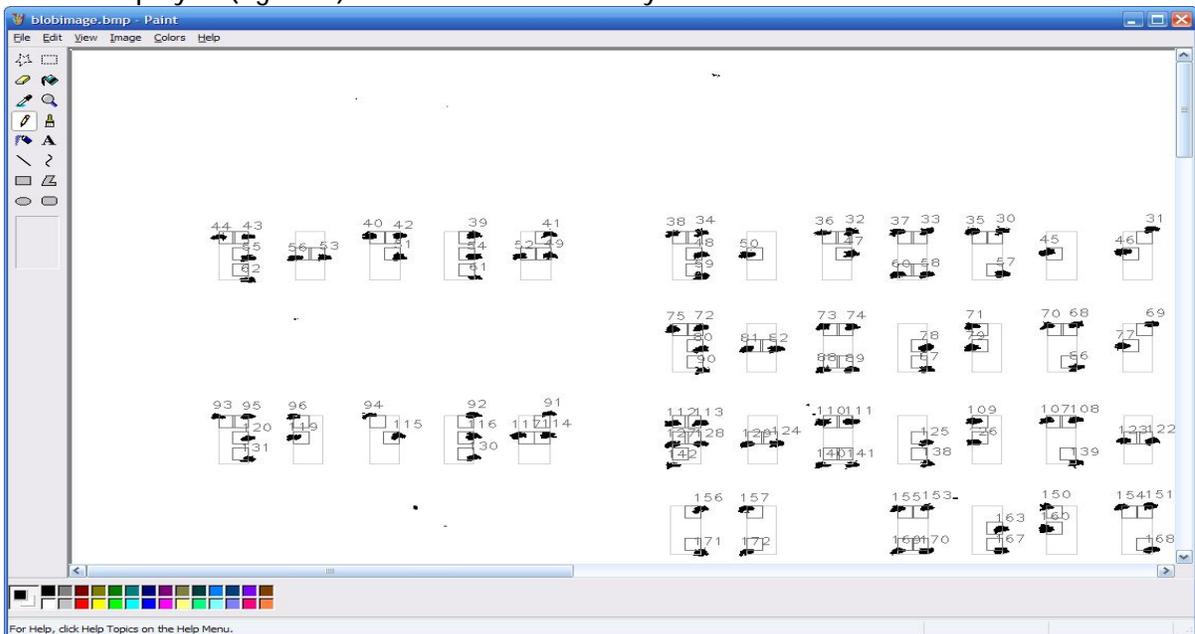


Figure - 8

3. **_Blob Editor_**: Once the JPG image file has been converted to ASCII (step 4.4), the user may view it in Braille, compare it to the original hard copy Braille and, edit it using the Blob Editor that has been provided in BrailleMath. This editing may be needed due to possible errors in the optical Braille recognition step. Frequently, the shadow of a Braille dot may be too faint to be recognized, causing the characters to be interpreted wrongly (A faint dot that has been ignored, will appear as a dot without a rectangle enclosing it when the "Image > Show Blob Image" option is used as explained in the previous section (see Figure 8)).

   - The blob editor displays the individual Braille characters as a series of 3x2 dots which can be turned on and off simply by clicking the mouse. The teacher performing the back-translation can load the ASCII Braille file into the blob editor and then compare it to the original Braille hard copy document, and fix any mistakes observed. To invoke the Blob Editor, select "Nemeth Translation > Invoke Blob Editor" (Figure 9).
   - The user can turn individual Braille dots on and off by simply clicking on them.
   - Once the ASCII file has been fixed, it must be saved, and the saved file opened in the BrailleMath system for translation to pdf.
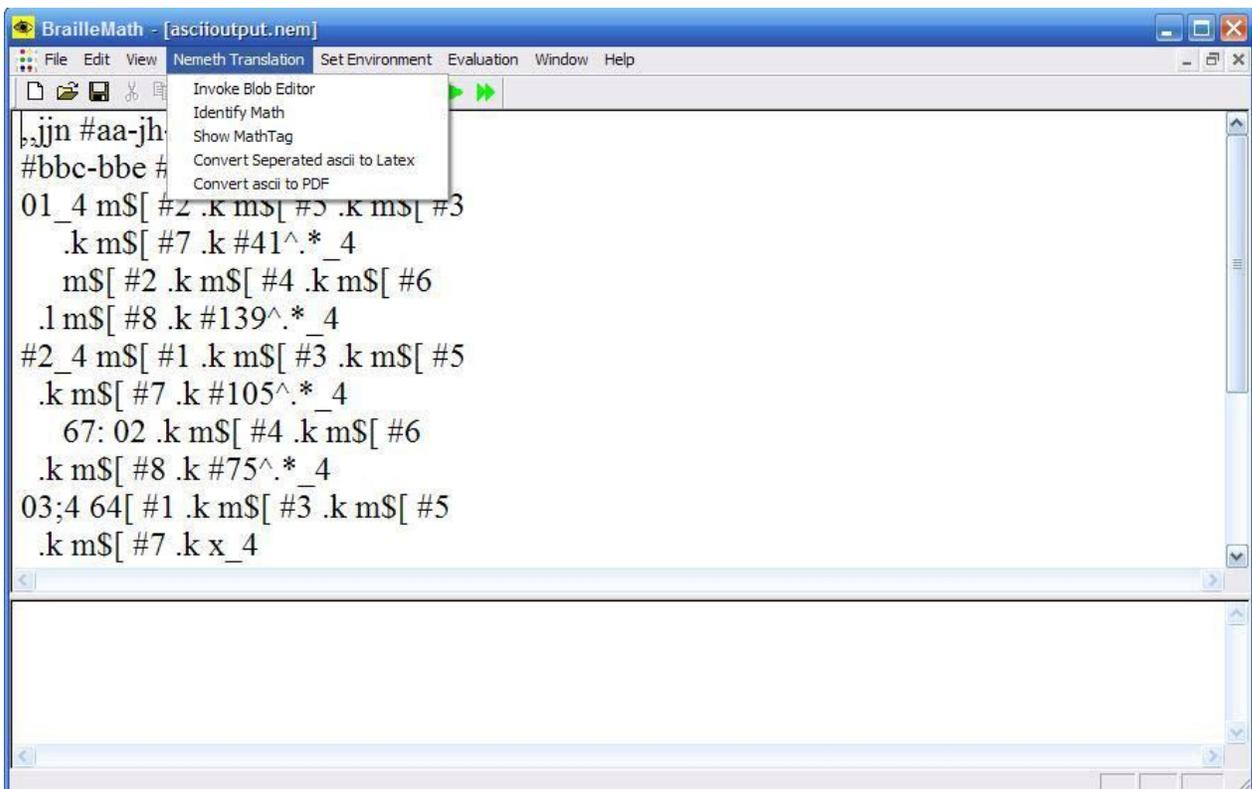


Figure 9

- The Blob Editor with an ASCII file loaded is shown below (Figure 10). Every raised dot recognized in the hard copy Braille sheet appears as a black dot.
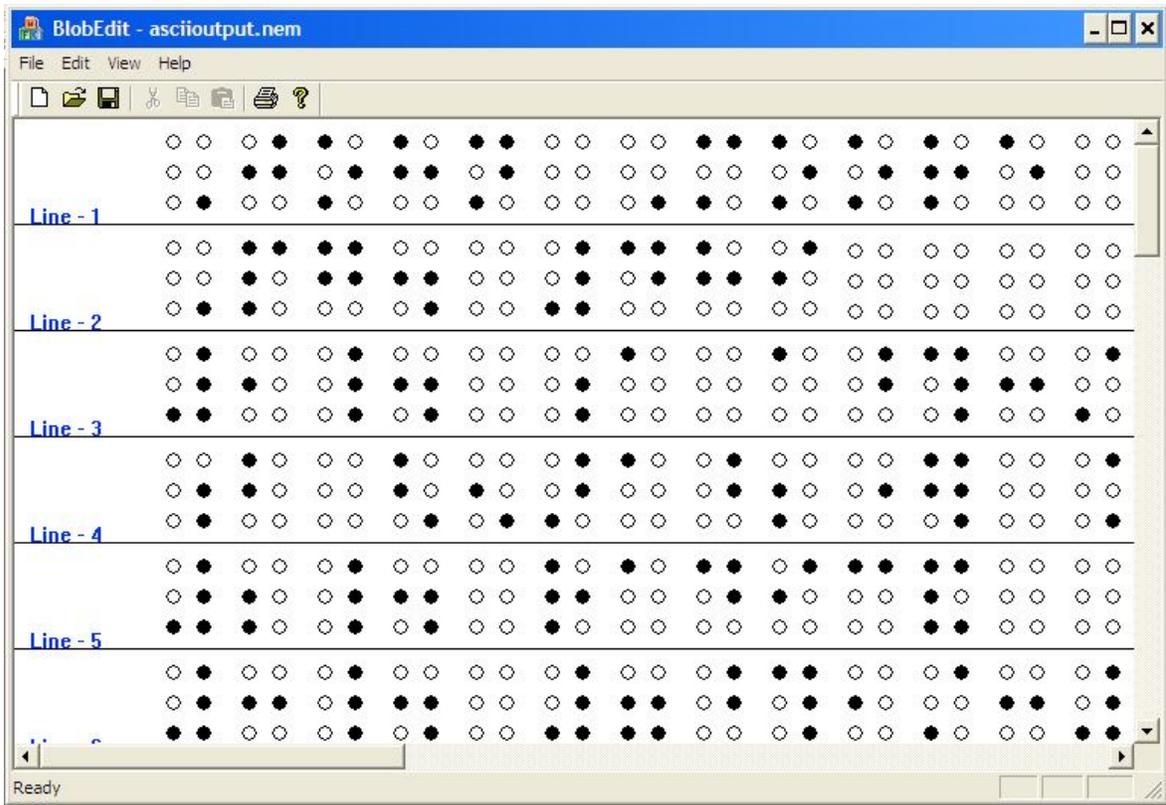
Figure 10

4. ***Translating Contracted Braille***: This feature allows user to translate contracted Braille phrases. As shown in the following figure (figure -11) user can input contracted Braille in the text box named "Enter Literary Braille Text". After pressing the "Translate" button, corresponding latex expression along with error message, if any, is displayed.
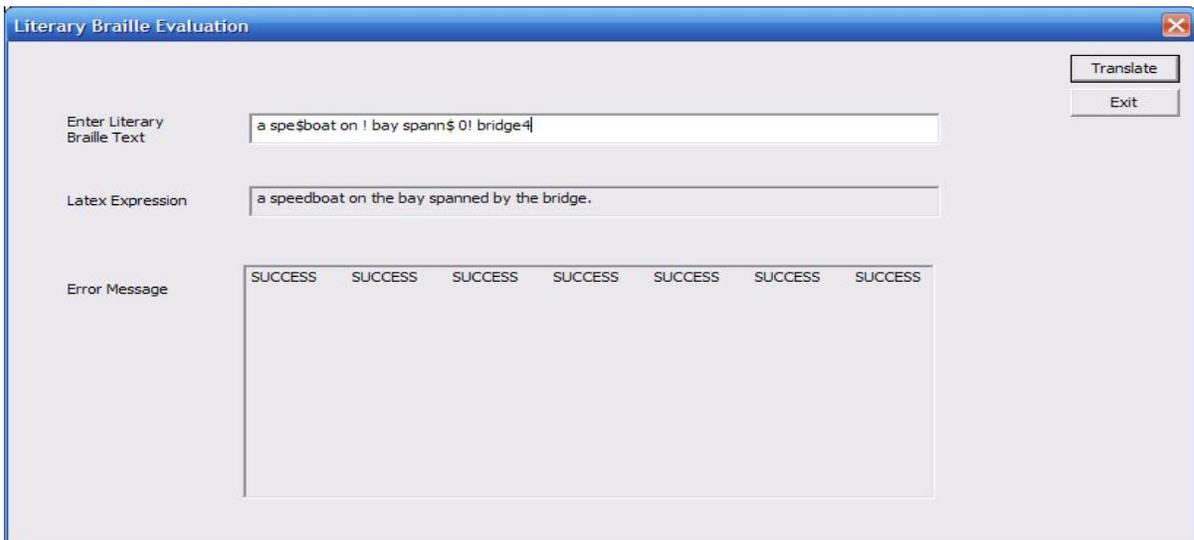

Figure - 11

5.  ***Translating  Nemeth Expression*** : This feature allows users to evaluate Nemeth Math expressions. As shown in the following figure (figure - 12) user can input Nemeth Expression in the text box named "Enter a Nemeth Math Expression". After pressing the "Translate" button, corresponding latex expression along with error message, if any, is displayed.
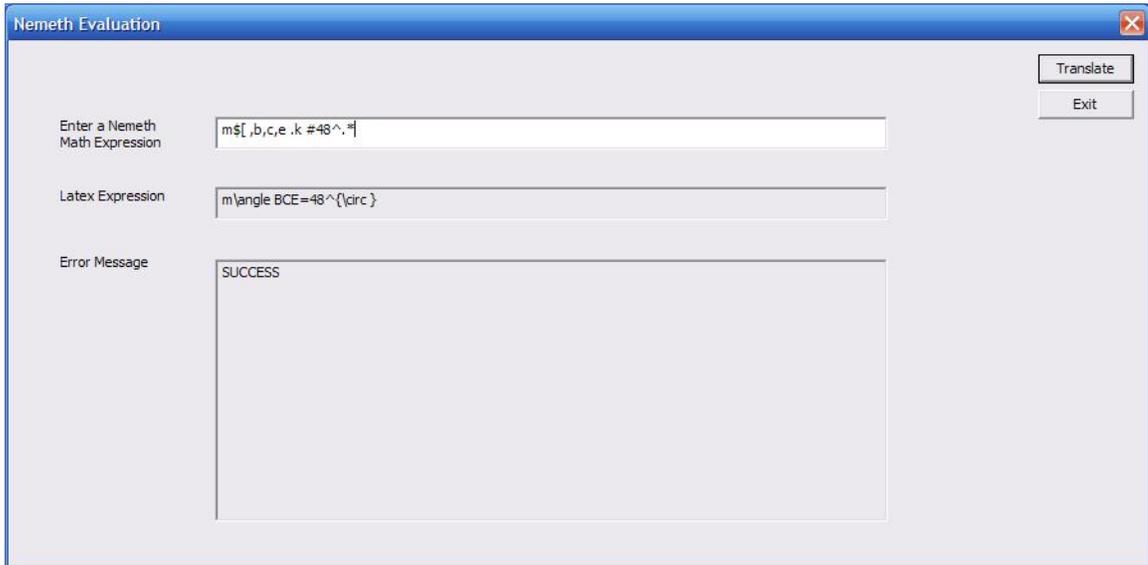


Figure – 12

6.  ***Set environment*** : It allows to set the following environment parameters:

A. Image threshold :
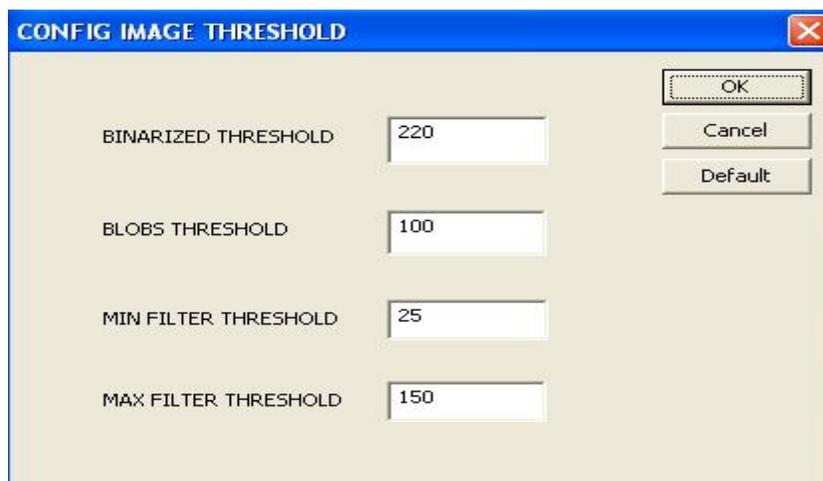


Figure – 13

As shown in figure 13, we can set four environment variables associated with image thresholds.

1. Binarized Threshold : Gray scale value used for binarizing pixels.

2. Blob Threshold :  Minimum number of **continuous** pixels for a blob to be considered as a black blob.

3. Min Filter Threshold:  Minimum number of pixels in a blob for it to be considered a Braille dot.

4. Max Filter Threshold:   Maximum number of pixels in a blob for it to be considered a Braille dot.

B. Image File name: It sets the output files names for the image processor. Dialog box that allows these file names to be set is shown in Figure 14.



Figure – 14
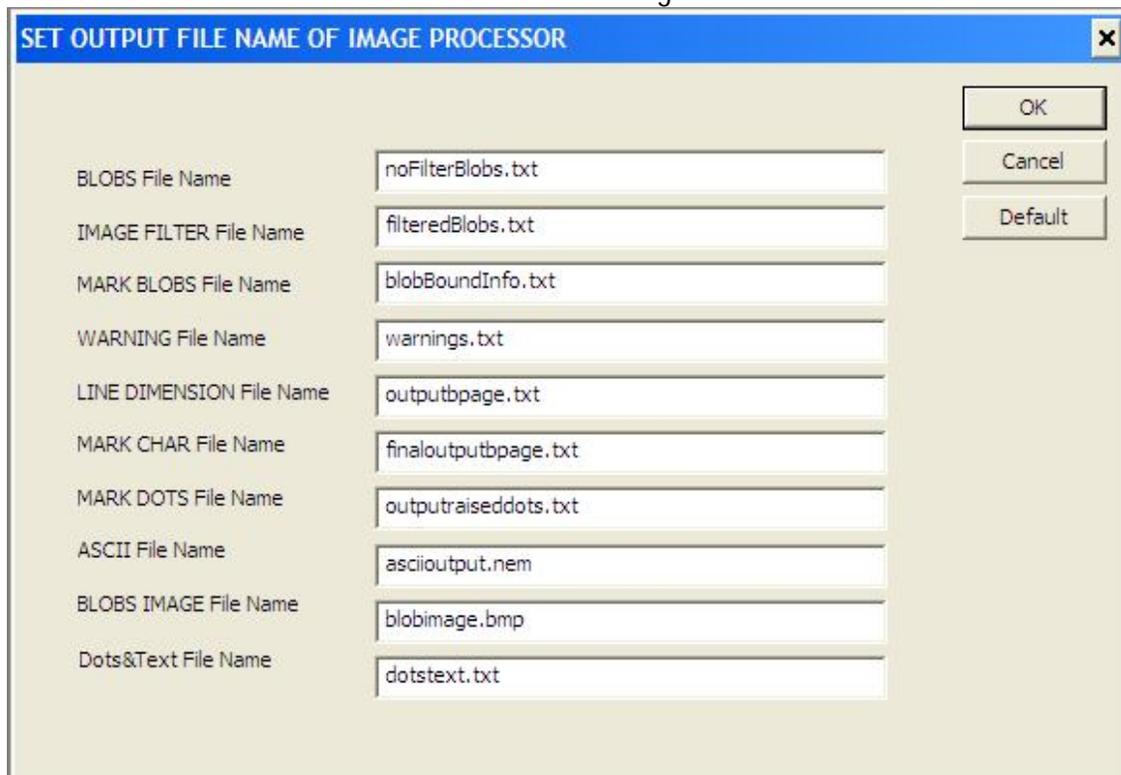
File names that can be changed are:
1. Blobs file name
2. Image filter file name
3. Mark blobs  file name
4. Warning file name

5. Line Dimension file name
6. Mark CHAR file name
7. Mark DOTS file name
8. ASCII file name
9. BLOBS image file name
10. Dots and text file name


C. Nemeth FileName: This option is used to set the file names for
1. Error report file name
2. Log file name.

It also asks whether to generate PDF file or not. The dialog box used for setting these options is shown in Figure 15.
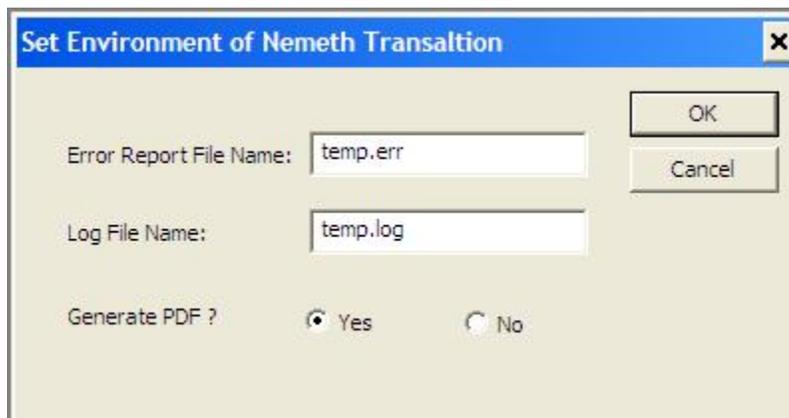


Figure – 15

## 5 APPENDIX

### 5.1 Sample image showing staple marks and ink marks on a Braille page
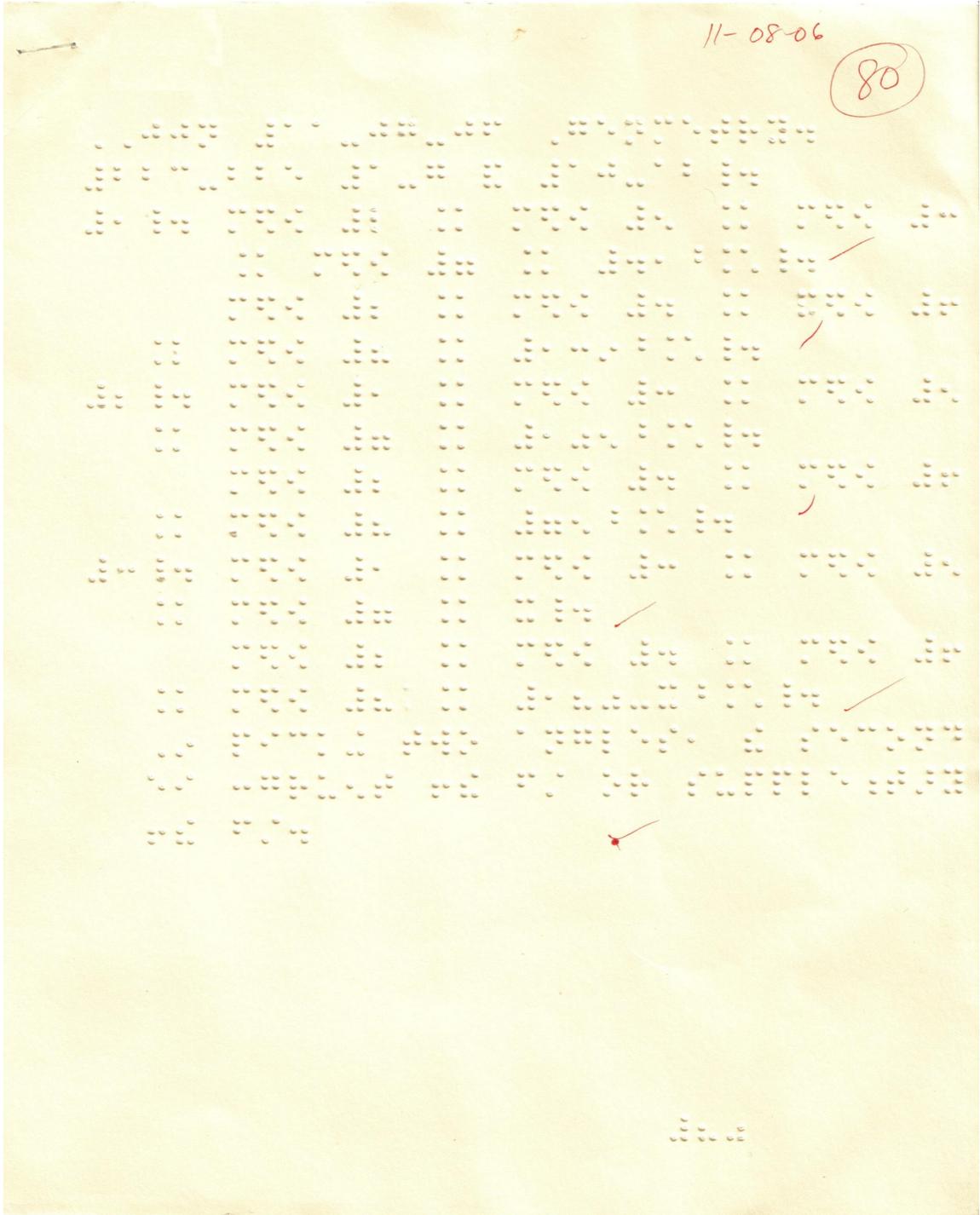


Figure – A1

## 6   TroubleShooting

→ *Scenario 1*: Nemeth file is opened and some changes are made to it and then the translator is called. But changes are not reflected in the output file. *Solution:* It is very important to note that every time you make any change in any of the open files, **the file should be explicitly saved** before using it as an input in any of the phases of the translation.

→ *Scenario 2* : While converting to PDF a black screen comes  as shown in figure – 12 and nothing happens after this



Figure - 12

*Solution:*  You will encounter this if there are some errors in the input document that cannot be translated correctly. The Latex system that converts Latex to Pdf may throw an error in such a situation. Latex will show the error it has encountered via the black screen. The black screen shows the line number in the latex file where the error occurred. You can either manually go and edit the latex file or just hit "Enter." If you hit "Enter" Latex will ignore the error and will resume producing the output.

→ *Scenario 3* : Following error message pop up
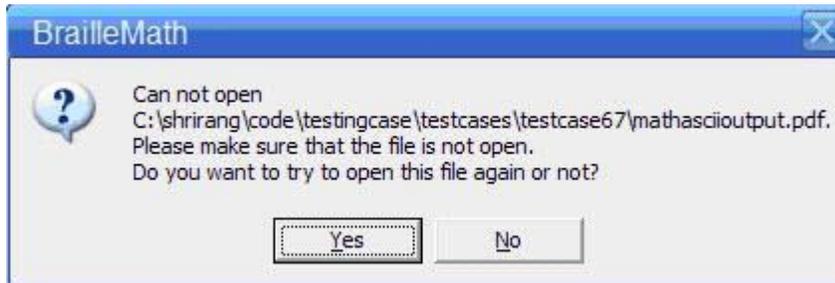


Figure - 13

*Solution*: Make sure that adobe acrobat reader is not open. If it is open then close it and rerun the translation.

## 7 Frequently Asked Questions

1. Do I need to install Aspell on my machine before using BrailleMath?
*A*. You need to install Aspell on your machine to run BrailleMath correctly. After you install Aspell, you need to add "C:\Program Files\Aspell\bin" to windows PATH.

2. Do I need to install acrobat reader?
A. Yes, you need to have adobe acrobat reader installed on your machine.

3. What if the final output looks strange?
A. In this scenario, perform the following checks:
    1. Check the blob image to find out if there is any problem in image recognition. If you see some problem, you can manually edit either the JPG image or the ASCII file using the Blob Editor.
    2. If it looks like that image recognition is correct, check the Nemeth Math delimited ASCII file. If it looks like that some part is not separated correctly you can add/remove <MATH> & </MATH> delimiters manually.
    3. Check the error file and log file to find any specific reason of errors.
    4. After doing these checks you can re-translate to Print Math format.
    5.  It may be possible that original Braille document has typing mistakes and/or occurrences of incorrect Nemeth code.

4. Sometimes nothing happens for many seconds.
A. Be Patient!!! Different modules such as image processing and math recognition do extensive checking / analysis so in some cases it may take up to few minutes to get the output.

5. Still have questions: Send email to info@interoperate.biz