**Better Braille Translation for Everyone  
Importance of Maintaining Liblouis**

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# Abstract

This paper describes RNIB’s systematic approach to reviewing and rectifying shortcomings in the open source Liblouis braille translation library relied on by popular screen reading and transcription products and services.

Since 2018, Royal National Institute of Blind People (RNIB) and international partners, have identified over 3,000 errors in the existing Unified English Braille (UEB) implementation, making Liblouis unsuitable in many education and employment settings. The paper describes the steps taken to collate lists of errors; work toward implementing corrections; collaboration with international partners for peer review.

Underpinning this work is the global move to digital braille delivery, lower cost braille technology and UEB’s reduced translation ambiguity.

While the Liblouis UEB table remains the primary focus of this work, other braille tables, e.g. Afrikaans, refer to the UEB table for underlying symbols.

The paper describes the process used to review the existing UEB tables, compile lists of errors, compare rules with dictionary, devise new rules, test against word lists, peer review and sign in changes.

Stakeholders standing to benefit from this work include, but are not limited to, individual users of screen readers and braille translation software, students, teachers, transcribers, publishers, hardware and software manufacturers and rehabilitation professionals. The paper proposes practical ways in which stakeholders can support the project improving braille translation accuracy for everyone.

# Background

Accurate braille translation, particularly to and from contracted braille, has traditionally required a meticulous process performed by a specialist human transcriber. While reliance on software tools to automate transcription has increased significantly in recent decades, affordable and consistent digital braille accuracy remains a significant challenge, especially in education and professional environments where accurate braille is required but braille expertise is scarce.

Since braille was developed in the 1820’s, tools to instantly convert text to braille and braille to text have never been so widespread. However, translation accuracy varies significantly between products and platforms, adversely impacting braille’s readability and comprehension, especially for beginners.

One of the stated ambitions of a Unified English Braille code was to reduce ambiguity in braille translation. The authors of this paper believe that benefit has yet to be fully realised. Braille readers reliant on automated translation are often forced to accept convenience and choice at the cost of poorly translated braille. So called “quick and dirty braille” translation, while often considered adequate for an experienced adult braille reader, may sometimes be unsuitable for braille beginners or any reader requiring a high degree of precision.

Screen reader translated braille offers the greatest potential for braille access to the widest range of mainstream content from commercial eBook platforms including Amazon Kindle, Apple Books, Google Play and others. Hundreds of millions of smartphones, tablets and laptops ship with embedded screen reading software supporting braille translation. Readers, with access to a refreshable braille display, can instantly read digital braille translated from any text shown on screen. Anyone with a low-cost tablet and braille display has access to millions of books in braille almost anywhere and at any time. Moreover, screen reader users can write in braille which is instantly back translated to text and shown on screen.

Accessible library services, such as Bookshare, offer an alternative to screen reader translated braille. Braille Ready Format (BRF) files are automatically produced with the reader’s choice of braille encoding and line length for embossing or reading with an electronic braille notetaker device.

Some accessible libraries, including RNIB Reading Services, offer high quality human transcribed electronic braille files for download. However, the number of titles in such collections represent a tiny fraction of published work. Human transcribed braille files are also written using the national braille code in use at the time of their production that may mean older work is challenging for some readers to interpret.

Finally, individuals can roll their own braille files using free or commercial braille translation tools such as Send to Braille or Braille Blaster. These tools often assume access to a desktop environment and basic computer skills. Due to digital rights management these tools are not officially compatible with commercial eBook services.

All of these approaches typically rely on one of two braille translation systems that define the rules for converting text to braille and braille to text:

1. Duxbury Systems is a commercial developer of highly regarded desktop braille translation software used in braille production environments and by braille publishers. Duxbury also licences specialised versions of their braille translation engine to commercial braille product manufacturers.
2. Liblouis is open-source braille translation software developed by a small group of volunteers. Products and services benefiting from Liblouis for braille translation include screen readers, braille notetakers, braille transcription packages, braille embossers and accessible digital libraries. Several commercial products incorporate both Duxbury and Liblouis to deliver benefits of both systems to readers.

This paper is primarily concerned with Liblouis development. However, improvements to Liblouis can also benefit Duxbury braille translation by sharing insights and errors.

# About Liblouis

The Liblouis software suite provides an off-the-shelf open-source braille translator, back-translator and formatter for over 100 languages and braille codes, including UEB. Liblouis is a set of libraries designed for use in any of a number of applications, both free and commercial. It is written in C so that it does not require a runtime environment and hence can be used in applications written in high-level languages such as Java and Python. Supported platforms include Windows, Mac and Linux.

Over 30 products are known to be using Liblouis for braille translation. The list includes many household names such as screen readers from Amazon, Apple, Google and Microsoft, as well as specialist assistive technology developers and braille publishers including American Printing House for the Blind, Benetech, Dolphin, Freedom Scientific, Help Tech, HIMS, HumanWare, Index Braille, National Braille Press, Orbit Research, ViewPlus and others.

# Partners

Royal National Institute of Blind people (RNIB) in the UK, is one of the largest braille transcribers and braille publishers in Europe. RNIB is a member of the United Kingdom Association for Accessible Formats (UKAAF) and in practice has been instrumental in the UK’s adoption of UEB. RNIB also operates the UK’s national hardcopy braille lending library. In 2020, RNIB launched RNIB Reading Services, a digital platform distributing accessible books to print disabled members in a variety of formats including electronic braille. RNIB was also one of the leading partners in the Transforming Braille Group, an international collaboration to bring to market a lower-cost refreshable braille display. The Orbit Reader 20 was the result of this effort and launched in the UK in 2018. Its successors Orbit Reader 20 Plus and Orbit Reader 40 include an onboard braille translator powered by Liblouis. RNIB also retails a number of other braille products based on Liblouis.

Other partners contributing to the Liblouis UEB effort include

* APH **–** Since 1858, The American Printing House for the Blind has operated in Louisville, Kentucky as the world’s largest nonprofit organization creating accessible learning experiences through educational, workplace, and independent living products and services for people who are blind and visually impaired.
* ViewPlus – Since 2000 ViewPlus has developed many braille printers, hybrid ink/braille printers, touchpads and a suite of software solutions developed to be scalable; running on the small portable personal braille printer to the larger production hybrid printers.
* Joseph Lee **–** A communication studies student, active contributor and advocate for NonVisual Desktop Access screen reader, Windows Insider passionate about accessibility. Current head list representative/owner of Win10 Forum for Screen Reader Users (win10.groups.io), former chair of NVDACon Planning Committee and NVDA international users mailing list.

# Justification

As has been established, increasing reliance on automated braille translation is widespread. Many popular products and platforms depend on Liblouis for braille translation. Braille learners and readers are often isolated from one another and have restricted access to braille expertise. For an increasing proportion of braille readers to receive accurate braille, an affordable accurate braille translation engine is required. Liblouis offers the only realistic prospect of a low-cost solution.

While community work began to add UEB to Liblouis in 2004, by 2018 colleagues at RNIB became aware that a significant number of braille translation issues remained outstanding. RNIB undertook to work with partners to make substantial improvements to Liblouis’s UEB support, that not only benefit readers, teachers, transcribers, and other supporting professionals in English-speaking countries, but also braille readers in countries whose national braille code incorporates aspects of UEB. This includes Afrikaans, Irish Gaelic, Hawaiian, Mandarin Chinese, Maori, Mongolian, Sotho, Turkish, and more.

While assembling a rudimental braille translation table is relatively straightforward, the task becomes increasingly challenging the closer accuracy gets toward 100%. This is particularly true in the English Language because of many exceptional words. A reference book on a braille code rightly gives rules and general examples, but cannot possibly include a complete list of all such exceptional cases. It is left to users, code developers and braille experts to identify and resolve the remaining translation errors not accounted for in braille rulebooks. Without the dedication of a committed team, this iterative development process can be sporadic and slow.

# Method

Collate reports of potential Liblouis UEB issues. RNIB received reports of braille translation anomalies in products based on Liblouis. Such reports were received from various sources, including individual users, user groups and organisations such as BANA and ICEB. Errors were then recorded by RNIB’s Braille Technical Specialist James Bowden during 2018 and 2019.

Initial Investigation. Each rule in the then current Liblouis table for UEB was tested against a corpus of 475,000 words. Where a known issue had been identified, a subset of words was produced featuring a specific contraction. for example, SH in the context of the group SHEAD. These words were added to the list of reported problems. The final list was then compiled into a Liblouis-style test dictionary. Of course, at this stage, most of the tests failed.

Detailed rule review. A manual check was then conducted, reading the results noting translation errors. For example, “Gateshead” should not use the SH sign.

Crosscheck. A search was then conducted for patterns, i.e. other similar words likely to exhibit a similar problem, for example, “crosshead”.

Exceptions. Note words that are exceptions of the rule being considered. For example, “sheading” (each of the six administrative divisions of the Isle of Man).

All words containing SHEAD, not at the start of a word, do not use the SH sign.

For all words that are now corrected as a result of the new rule, the corresponding test in the test file should now pass. Add these new test words to the main Liblouis dictionary test file.

At all stages, run the Liblouis test programme to compare auto-translated with given correct output.

As well as reviews concentrating on small groups of words, such as those containing groups like SHEAD, CCH, FFOR and TIMENT, larger groups were also tested, for example all words starting DEA-, PREA- and REA-. These reviews encompassed many more words, often seeming like reading through a dictionary. At times, it was not always obvious how to contract particular words. We are indebted to the thoughtful consideration of the members of ICEB Code Maintenance Committee (CMC) and in particular to the Code Maintenance Officer, Phyllis Landon, who helped to resolve many questions.

The English language is a complex one when it comes to spelling, pronunciation and word composition. This is often reflected in the way particular words are written in braille and the rules surrounding the braille contractions.

As an observation, we note that perhaps the most difficult braille contractions in UEB are the prefixes BE-, CON- and DIS- (particularly BE-) and the groupsign ONE – complex because of the syllabic nature of their rules and the volume of possible words which may or may not use the signs.

Research by Dr. Robert Englebretson demonstrates the importance of getting the braille contractions correct, as readers do not reverse the effect of the contractions (back into simple individual letters) but "chunk"; some might almost treat the braille contractions as phonics, even though the rules rarely mention pronunciation as such. The result of misbrailling a word can often be mispronunciation by the reader, or a double-take. The simplest example perhaps is the word “then”, which may be mispronounced if written with the TH sign instead of the THE sign. Likewise, “mishear”, written with the SH sign would most likely be mispronounced. So, too, if the word “reaching” was written without the EA sign, the braille reader may be tempted to think of “aching again” – or the converse case if “reacting” were written with the EA sign, the reader may well be confused.

# Peer Review

Once a substantial number of words were fixed, a peer review process verified correct results. The list of fixes was essentially the same as the new entries added to the main Liblouis test dictionary. The list of fixes was split into chunks and these were sent to volunteers taken from the ICEB Refreshable Braille Technology list. Their help in checking the work is very much appreciated.

# Results

Liblouis Release 3.12.0 built on 2 Dec 2019 contained the following release note.

“Major Improvements to contraction use in UEB thanks to James Bowden.”

To date 3,000 words have been contributed to the test dictionary and many of these have been corrected in the main Liblouis branch. Examples include: archdeaconess, autofocus, Beatrix, bighead, biofuel, boathouse, bolthole, eyedrop, Gateshead, lemongrass, maisonette, mishit, oversentimental, plughole, Queenstown, reacquaint, saccharide, stouthearted, tradename, Trafford, unaffordable, Washingtonese, and many, many more.

Note that some of the words might be considered rare, such as complex medical terms, but often these fall into a general pattern and so fixing the more common word may help with more complex ones too.

NVDA version 2020.1 was the first screen reader to adopt Liblouis braille translator to version 3.12. Other screen readers and braille translation systems are expected to follow.

Orbit Reader 20 Plus is also confirmed to be using Liblouis 3.12.0 or later.

# Conclusions and Calls to Action

The work undertaken so far represents a substantial improvement in the standard of UEB translation by Liblouis. The work concentrated on contraction usage, particularly in the print to braille direction. More work is still required, for example in the area of symbol assignment, and there remain several more braille contractions on the to-do list.

Though more work is undoubtedly needed, RNIB’s contribution to Liblouis is now benefiting braille readers around the world who rely on braille products built using Liblouis.

To deliver the best possible experience for braille readers and other stakeholders, it is suggested product developers build and test with the most current version of Liblouis at the earliest opportunity. New versions of Liblouis are released every quarter.

Given the critical role Liblouis plays in braille translation around the world, all stakeholders are strongly encouraged to engage and support continued Liblouis development. This could be through financial sponsorship of Liblouis directly or of a leading partner, or through technical contributions to develop the table rules, or even the core Liblouis engine.

# References

Products known to be using Liblouis

https://github.com/liblouis/liblouis/wiki/Products-that-use-Liblouis

Send to Braille, free “quick and dirty braille” translator

<https://tech.aph.org/lt/>

Braille Information from RNIB

https://www.rnib.org.uk/practical-help/reading/braille-and-moon-tactile-codes

Liblouis version 3.12

www.github.com/liblouis/libouis/pull/786

Fischer-Baum, Simon and Robert Englebretson. 2016. "Orthographic units in the absence of visual processing: Evidence from sublexical structure in braille". Cognition, 153: 161-174.

NVDA release note including first screen reader implementation of Dec 2019 Liblouis UEB fixes

https://github.com/nvaccess/nvda/issues/10161

Liblouis release schedule:

https://github.com/liblouis/liblouis/wiki/Release-schedule

Liblouis sponsorship:

http://liblouis.org/sponsoring/