

# SOFTWARE ASSISTING TOOLS IN TEACHING AND LEARNING FOR MYANMAR STUDENTS WITH VISUAL DISABILITIES (Research in Progress)

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**ABSTRACT:** Information and communication technologies should be available not only for normal users but also for users with disabilities. We still need gap control especially for students with disabilities in developing countries such as Myanmar. My research focuses on software tools and user interfaces that can assist education for visual disabilities. Braille is a writing system or communication method that is widely used by blind or visually impaired people to read and write. This paper proposes a Direct Keyboard Mapping (DKM) keyboard layout for Myanmar Braille called Mu Thit.

**Keywords:** assistive technologies, Myanmar Braille, Mu Thit, Mu Haung, Direct Keyboard Mapping (DKM)

## I. INTRODUCTION

Direct Keyboard Mapping is a method to map Myanmar Braille codes based on the current Myanmar PC keyboard layouts. I assume that it is easier and short learning curve for users (i.e. not blind or visually-impaired users) who are already familiar with Myanmar keyboard layout. I did survey on existing keyboard layouts and typing methods to find out applicable keyboard layout for Myanmar Braille. As a result, I selected Myanmar 3 Unicode keyboard layout for Direct Keyboard Mapping prototype development. Myanmar Braille font “mmBraille.ttf” version 1.0 is also developed for testing Direct Keyboard Mapping of Mu Thit or Grade (1) Myanmar Braille.

This research is work in progress and now making survey on another Myanmar Braille system called Mu Haung. The difference, pros and cons between Mu Thit and Mu Haung based on the current survey result is also presented. I believe that the outcome of this research is useful for creation of Braille educational contents and communication between visually-impaired and general users.

## II. MYANMAR BRAILLE

The Braille system is a method that is widely used by blind people to read and write, and was the first digital form of writing [1]. It was devised by a blind Frenchman Louis Braille in 1825 [2]. It is a system of touch reading for the blind that employs embossed dots evenly arranged in quadrangular letter spaces or cells. In each cell, it is possible to place six dots,

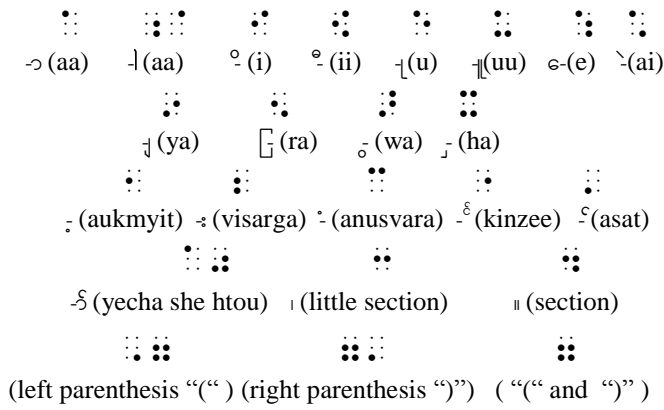
three high and two wide [3]. By selecting or raising one or several dots in combination, 64 different characters can be formed (i.e.  $2^6 = 64$ ), including the cell that no dots are selected or raised. For easier human reading or reference purpose, the six dots of the cell are numbered 1, 2 and 3, top to bottom on the left and 4, 5 and 6, top to bottom on the right (e.g. dots 1-3-4-5 for “:.”).

### A. Grade (1) Myanmar Braille or Mu Thit

In the early 19th century, the first Myanmar Braille was devised by a Myanmar blind man U Phay Gyi [4]. In 1917, Father Jackson developed a new Myanmar Braille based on English Braille characters and pronunciation of Myanmar language. It is faster for writing and reading than U Phay Gyi’s Myanmar Braille and widely used. In 1967, Myanmar Braille called Mu Thit was developed with the leading by Ministry of Social Welfare, Relief & Resettlement Department. It represents all of the Myanmar characters in Braille codes, and writing order is totally based on Myanmar language writing system (see Figure 1, Figure 2 and Figure 3). Mu Thit is also known as Myanmar Braille Grade (1).

က (ka)	ခ (kha)	ဂ (ga)	င (gha)	စ (nga)
စ (ca)	ဆ (cha)	ဇ (ja)	ည (jha)	ဉ (nya)
တ (ta)	ထ (tha)	ဒ (da)	ဌ (dha)	န (na)
ပ (pa)	ဖ (pha)	ဗ (ba)	ဘ (bh)	မ (ma)
ယ (ya)	ရ (ra)	လ (la)	ဝ (wa)	သ (sa)
ဟ (ha)	ဣ (lla)	အ (a)	ဥ (nya)	

Figure 1. Consonant



⠠⠠⠠  
 သ (great sa)

Figure 2. Vowel, Consonant Sign, Various Sign and Symbol

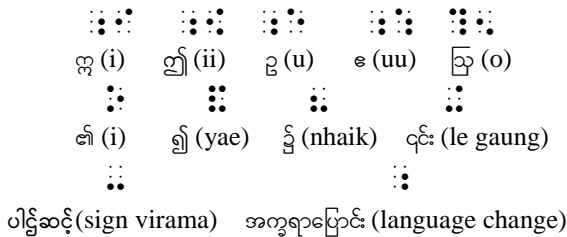


Figure 3. Independent Vowel and Symbol

#### B. Grade (2) Myanmar Braille or Mu Haung

In 2005, Grade (2) Myanmar Braille was also developed by collaboration work of Myanmar Christian Fellowship of The Blind (M.C.F.B), School for the Blind (Kyimyindine) and Ministry of Social Welfare, Relief & Resettlement Department. It is a modified version of Father Jackson's Myanmar Braille and different from Myanmar language writing system. The followings are three examples of Grade (2) Myanmar Braille syllables:

- 1) က (က + ) is written as ⠠⠠⠠⠠⠠⠠⠠⠠ (က + အ),
- 2) ကွန်: (က + ဝ + န + န် + ) is written as ⠠⠠⠠⠠⠠⠠⠠⠠ (က + အွန် + ),
- 3) ခွတ် (ခ + ဝ + တ + န်) is written as ⠠⠠⠠⠠⠠⠠⠠⠠ (ခ + အွတ်)

The merit of Myanmar Braille is faster writing and reading than Grade (1) Myanmar Braille. As mentioned in the above examples, it is based on pronunciation and caused many ambiguities problems. Grade (2) Myanmar Braille or Mu Haung codes can be seen in Figure 4, Figure 5, Figure 6 and Figure 7.

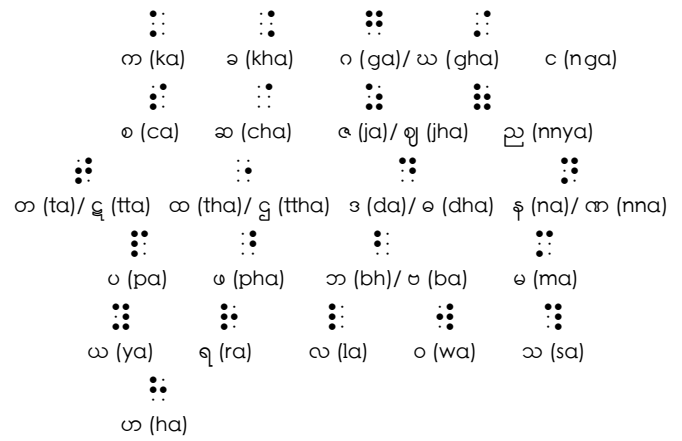


Figure 4. Consonant

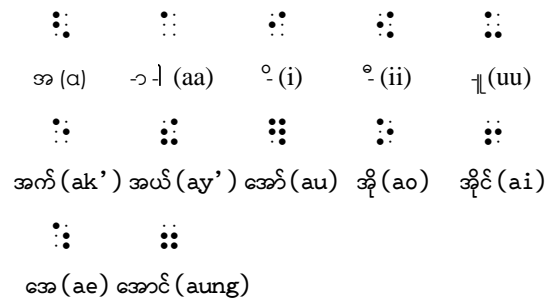


Figure 5. Vowels

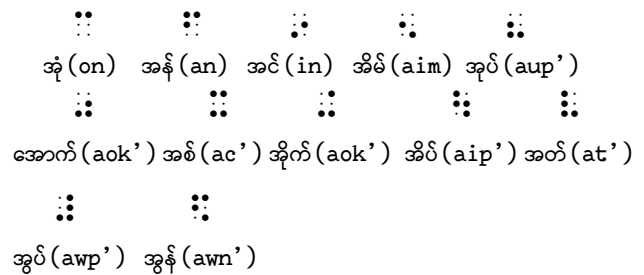


Figure 6. Thara Tu (Pseudo Vowels)

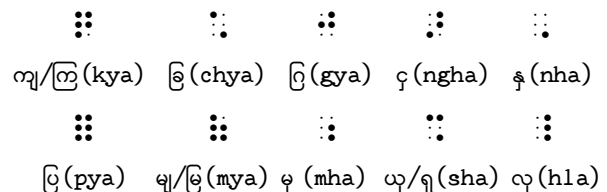


Figure 7. Byii Tu (Pseudo Consonant Sign)

In Grade (2) Myanmar Braille writing method, syllables are basically formed by combinations of consonant with pseudo vowels or pseudo consonant signs. Depending on the contents of the sentence, special vowels are also used instead of Thara Tu (Pseudo Vowels) in order to reduce ambiguities. For example, အိန for အင်, အိတ for အစ်, အာန for အန်, အိုန for အို, အေန for အိမ် and အိုက for အုပ် etc. There are many contractions in Grade (2) Myanmar Braille like in English Braille such as “ကလ” for “ကာလ”, “ကသ” for “ကဲ့သို့”, “ကး” for “ကိုး”, “ကျတ” for “ကျွန်တော်”, “ကျဇ” for “ကျေးဇူး”, “မန” for “မည်နည်း” etc.

### III. RELATED WORKS

This section introduces two typing methods of English Braille on a PC keyboard. Encoding methods of English characters are already standardized (for example, ASCII, Windows 1252 (Latin I) and ISO/IEC 8859-1 Latin Codepage etc.) and the process conversion from one font to another is easy. However, there is no official standardization for Myanmar language encoding, and several encoding methods are used in Myanmar fonts (for example, WinMyanmar, ZawGyi and Myanmar3 etc.). And thus, font converter software is necessary to change from one Myanmar font to another. I introduce two Myanmar font converters ALO and LeikPyar that provide Myanmar text to Myanmar Braille, and both of them use English Braille font for displaying Myanmar Braille codes.

#### A. Braille Typing on a PC Keyboard

English Braille can type by using any text editor or word processor and then change to Braille font to see Braille codes. The important factor is that users have knowledge of English Braille writing method including contractions, abbreviations and formats etc. [5][6]. Font changing from Myanmar text to Braille code is possible, but a Braille font mapping needs to be created based on Myanmar font. Another problem to be solved is conversion errors caused by Unicode encoding. This is because Unicode encoding is not identical to Myanmar handwriting order, and Myanmar Braille writing is the same as handwriting order (for example, ကြ syllable saves as “က + ြ” in Unicode encoding and writes as “ြ + က” in Myanmar Braille).

#### B. Six-Key Entry on a PC Keyboard

Six-key entry is a typing method of Braille codes by using six keys of PC keyboard like typing in Perkins brailler. ‘s’, ‘d’, ‘f’, ‘j’, ‘k’ and ‘l’ keys of QWERTY keyboard are used for the dot positions 3, 2, 1, 4, 5 and 6. This requires the keyboard’s capability of capturing simultaneous key codes from two up to six keys (for example, pressing f and s keys simultaneously to type Myanmar consonant ka “:”) as well as key code from a single key. The simulation software such as “Perky Duck” for six-key typing is also required [7].

#### C. ALO Myanmar Braille Translator (Version 1.0)

ALO (Aung Lwin Oo) Myanmar Braille Translator was developed by a blind Myanmar computer programmer Aung Lwin Oo and launched in March 2011 [8][9]. It provides translation of Myanmar text encoded with both partial Unicode

font (e.g. Zawgyi font) and full Unicode font (e.g. Myanmar3 font) to Grade (1) Myanmar Braille [10][11]. It also supports translation of Grade (1) Myanmar Braille to Myanmar text and vice versa. It is simple user interface but does not support contractions, abbreviations, formats or math symbols of Braille.

#### D. LeikPyar Myanmar Unicode Converter

LeikPyar Myanmar Unicode Converter was developed by Solveware Solution [12]. Its main function is conversion among different Myanmar fonts. Currently there are several methods to encode Myanmar characters for use on a computer, and there exists no official encoding standard yet. And thus, font conversion software such as LeikPyar, DocCharConvert and Burmese Font Converter were developed by freelance programmers or companies for users demanding [13][14]. Among them, LeikPyar supports font conversion from Myanmar text to Grade (1) Myanmar Braille. Its user interface can be seen in Figure 8. It does not support contractions, abbreviations, formats or math symbols of Braille.

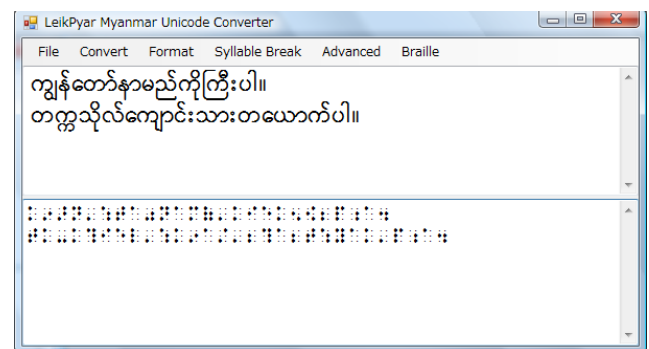


Figure 8. User Interface of LeikPyar Unicode Converter

### IV. TYPING ORDERS OF MYANMAR TEXT

This section explains handwriting, typewriter and PC keyboard typing orders of Myanmar text that I already presented at SNLP 2009 [15].

Basically, there are three types of typing order for Myanmar language; handwriting order, traditional typewriter order (Martin Tytell) and PC keyboard order [16].

General Handwriting order is 1) left vowel (i.e. “ေ”), 2) consonants (e.g. “က”, “ခ”, “ဂ”, “ဃ” and “င” etc.), 3) medials (“ြ”, “ျ”, “ွ” and “့”), 4) upper vowels (e.g. “ို”, “ို” and “ဲ” etc.) and lower vowels (e.g. “ု”, “ု” and “ံ” etc.), 5) killers (e.g. “်”, “်”, “်” and “်” etc.) and 6) right vowels (e.g. “ံ”, “ံ”, “ံ” and “ံ” etc.). Handwriting order for Myanmar word “မြို့”(city) is as follows:

$$\text{ဝ} + \text{ြ} + \text{ို} + \text{်} + \text{ံ} = \text{မြို့}$$

Traditional typewriter typing order depends on typists and there are various typing orders. According to the result of my survey with ten typists, there are four types of typing orders for

[illegible]
$$[ + \ominus + \overset{\circ}{-} + - ] + \underset{\cdot}{-} = \boxed{\underset{\cdot}{-}}.$$
$$0 + {}^c_{} + 0 = \underset{0}{0}$$

ဤသို့ဖြင့်အနော်ရထာမင်းကြီး၏ဦးဆောင်မှုအောက်တွင် ပုဂံသားတို့သည် စုပေါင်းညီညွတ်စွာဖြင့်အင်အားကြီးမားသောမြန်မာနိုင်ငံတော်ကြီးကို တည်ထောင်နိုင်ခဲ့လေသည်။

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100. 101. 102. 103. 104. 105. 106. 107. 108. 109. 110. 111. 112. 113. 114. 115. 116. 117. 118. 119. 120. 121. 122. 123. 124. 125. 126. 127. 128. 129. 130. 131. 132. 133. 134. 135. 136. 137. 138. 139. 140. 141. 142. 143. 144. 145. 146. 147. 148. 149. 150. 151. 152. 153. 154. 155. 156. 157. 158. 159. 160. 161. 162. 163. 164. 165. 166. 167. 168. 169. 170. 171. 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200. 201. 202. 203. 204. 205. 206. 207. 208. 209. 210. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 222. 223. 224. 225. 226. 227. 228. 229. 230. 231. 232. 233. 234. 235. 236. 237. 238. 239. 240. 241. 242. 243. 244. 245. 246. 247. 248. 249. 250. 251. 252. 253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264. 265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276. 277. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288. 289. 290. 291. 292. 293. 294. 295. 296. 297. 298. 299. 300. 301. 302. 303. 304. 305. 306. 307. 308. 309. 310. 311. 312. 313. 314. 315. 316. 317. 318. 319. 320. 321. 322. 323. 324. 325. 326. 327. 328. 329. 330. 331. 332. 333. 334. 335. 336. 337. 338. 339. 340. 341. 342. 343. 344. 345. 346. 347. 348. 349. 350. 351. 352. 353. 354. 355. 356. 357. 358. 359. 360. 361. 362. 363. 364. 365. 366. 367. 368. 369. 370. 371. 372. 373. 374. 375. 376. 377. 378. 379. 380. 381. 382. 383. 384. 385. 386. 387. 388. 389. 390. 391. 392. 393. 394. 395. 396. 397. 398. 399. 400. 401. 402. 403. 404. 405. 406. 407. 408. 409. 410. 411. 412. 413. 414. 415. 416. 417. 418. 419. 420. 421. 422. 423. 424. 425. 426. 427. 428. 429. 430. 431. 432. 433. 434. 435. 436. 437. 438. 439. 440. 441. 442. 443. 444. 445. 446. 447. 448. 449. 450. 451. 452. 453. 454. 455. 456. 457. 458. 459. 460. 461. 462. 463. 464. 465. 466. 467. 468. 469. 470. 471. 472. 473. 474. 475. 476. 477. 478. 479. 480. 481. 482. 483. 484. 485. 486. 487. 488. 489. 490. 491. 492. 493. 494. 495. 496. 497. 498. 499. 500. 501. 502. 503. 504. 505. 506. 507. 508. 509. 510. 511. 512. 513. 514. 515. 516. 517. 518. 519. 520. 521. 522. 523. 524. 525. 526. 527. 528. 529. 530. 531. 532. 533. 534. 535. 536. 537. 538. 539. 540. 541. 542. 543. 544. 545. 546. 547. 548. 549. 550. 551. 552. 553. 554. 555. 556. 557. 558. 559. 560. 561. 562. 563. 564. 565. 566. 567. 568. 569. 570. 571. 572. 573. 574. 575. 576. 577. 578. 579. 580. 581. 582. 583. 584. 585. 586. 587. 588. 589. 590. 591. 592. 593. 594. 595. 596. 597. 598. 599. 600. 601. 602. 603. 604. 605. 606. 607. 608. 609. 610. 611. 612. 613. 614. 615. 616. 617. 618. 619. 620. 621. 622. 623. 624. 625. 626. 627. 628. 629. 630. 631. 632. 633. 634. 635. 636. 637. 638. 639. 640. 641. 642. 643. 644. 645. 646. 647. 648. 649. 650. 651. 652. 653. 654. 655. 656. 657. 658. 659. 660. 661. 662. 663. 664. 665. 666. 667. 668. 669. 670. 671. 672. 673. 674. 675. 676. 677. 678. 679. 680. 681. 682. 683. 684. 685. 686. 687. 688. 689. 690. 691. 692. 693. 694. 695. 696. 697. 698. 699. 700. 701. 702. 703. 704. 705. 706. 707. 708. 709. 710. 711. 712. 713. 714. 715. 716. 717. 718. 719. 720. 721. 722. 723. 724. 725. 726. 727. 728. 729. 730. 731. 732. 733. 734. 735. 736. 737. 738. 739. 740. 741. 742. 743. 744. 745. 746. 747. 748. 749. 750. 751. 752. 753. 754. 755. 756. 757. 758. 759. 760. 761. 762. 763. 764. 765. 766. 767. 768. 769. 770. 771. 772. 773. 774. 775. 776. 777. 778. 779. 780. 781. 782. 783. 784. 785. 786. 787. 788. 789. 790. 791. 792. 793. 794. 795. 796. 797. 798. 799. 800. 801. 802. 803. 804. 805. 806. 807. 808. 809. 810. 811. 812. 813. 814. 815. 816. 817. 818. 819. 820. 821. 822. 823. 824. 825. 826. 827. 828. 829. 830. 831. 832. 833. 834. 835. 836. 837. 838. 839. 840.

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၂၄၆ = အိ = ဤ၊ ၁၄၅ = ဒ = သို့၊ ပြဟ = ဖြင့်၊ နအော် = နော်၊ ကျအီး = ကြီး၊ သ = သည်၊ စအောင် = ဆောင်၊ ၃၅၆ = အောက်၊ ၂၄၅ = တို့၊ ညအူတ = ညွတ်၊ ၁၂၃၆ = သော်၊ ၁၂၃၆ ၂၃ = သော် + ခ် = သော၊ ၁၃၄၅ = န = နိုင်၊ ၂၅၆ = ။

As a first step, a true type font was developed for Myanmar Braille before software keyboard implementation. Although existing Braille fonts such as “Braille.ttf”, “SimBraille.ttf” are usable for displaying Myanmar Braille, I decided to develop a new Myanmar Braille font for several reasons. The main reason is that mapping Myanmar Braille code based on a Myanmar character font mapping can provide easier typing of Myanmar Braille codes. As far as I know, no font had been designed specifically for Myanmar Braille. I decided to develop a TrueType font for Myanmar Braille rather than other font types such as PostScript and OpenType [17]. This is because TrueType fonts worked fine on the Windows as well as Mac, and it is enough for my direct keyboard mapping study. I used a FontLab Studio version 5 for developing

[illegible]

## VII. DIRECT KEYBOARD MAPPING FOR MYANMAR BRAILLE

As a first step, I studied existing Myanmar PC and typewriter keyboard layouts. From this study, I can say that almost all Myanmar PC keyboards mappings are based on traditional typewriter and similar keyboard mapping especially for consonants, but some different mappings exist for vowels, medials and subscript consonants (see Table I) [15]. Following this result, I decided to use “Myanmar3 keyboard layout” that is one of the existing Myanmar Unicode keyboard layouts developed by Myanmar Unicode and NLP (Natural Language Processing) Research Center [11].

| Key (Shift)                  | Q      | W      | E      | R      | T      | Y      |
|------------------------------|--------|--------|--------|--------|--------|--------|
| (Unshift)                    | q      | w      | e      | r      | t      | y      |
| WinMyanmar<br>ASCII Ver. 2.6 | ၂<br>ဆ | ၃<br>တ | ၄<br>န | ၅<br>မ | ၆<br>အ | ၇<br>ဇ |
| Zawgyi Myanmar<br>(Unicode)  | ၂<br>ဆ | ၃<br>တ | ၄<br>န | ၅<br>မ | ၆<br>အ | ၇<br>ဇ |
| Myanmar3<br>(Unicode)        | ဈ<br>ဆ | ဝ<br>တ | ဏ<br>န | ဓ<br>မ | ဍ<br>အ | ဏ<br>ဇ |

|                           |   |   |             |             |   |
|---------------------------|---|---|-------------|-------------|---|
| <b>Myanmar Consonant</b>  | ဓ | ဓ | ဂ           | ဃ           | င |
| <b>Equivalent Braille</b> | ⠠ | ⠠ | ⠠           | ⠠           | ⠠ |
| <b>Key</b>                | u | c | Shift<br>+: | Shift<br>+c | I |



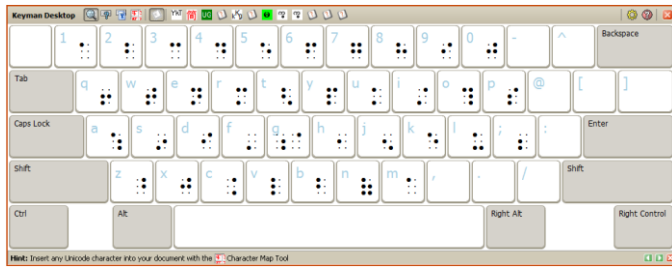


Figure 10. Keyboard Layout of Mu Thit (unshift)

### VIII. DISCUSSION

I developed “mmBraille.ttf” version 1.0 for both Myanmar Braille Grade (1) and Grade (2) and testing DKM layout of Mu Thit. Although existing Braille fonts such as “Braille.ttf” and “SimBraille.ttf” are available for Myanmar Braille typing, conversion software is required to change Braille codes to Myanmar text and vice versa. This is because font mapping of “Braille.ttf” and “SimBraille.ttf” is not equivalent to that of Myanmar fonts. For example, Mu Thit Braille codes equivalent of the example Myanmar sentence mentioned in section V are saved or encoded as English characters. And thus, the output of font changing of Mu Thit Braille codes to Myanmar3 font is as follows:

;[?ie1^5/'1<:na0rjam/'2k5[2o:e[2:6a/'mxel:<ak't>/'pegc?a2t  
ie1?('se:p;a/'2[(('t's>a^5/'1</'<a2k5[2ma2:?am5n'manie/'/c:ta0  
k5[2kiet('ja/'nie/'.\*1:l?('4

Obviously, without conversion software, users cannot see the equivalent Myanmar characters. Although “Braille.ttf” and “SimBraille.ttf” are useful for displaying universal Braille codes, they do not support typing Myanmar Braille with Myanmar keyboard layout.

Current DKM keyboard prototype is designed to type all Mu Thit Myanmar Braille (Figure 1, Figure 2 and Figure 3) codes with a one keystroke. For example, Mu Thit Myanmar Braille “::” (i.e. equivalent to Myanmar character “၌”) can be typed by pressing “Shift + t or T” key once.

Both mmBraille.ttf and DKM keyboard layout of Mu Thit are work in progress, formal analysis and user study on DKM keyboard layout are yet to be made.

From this study, the following important factors have been found relating to Myanmar Braille Grade (1) and Grade (2).

1. Grade (1) needs to type more Braille codes than Grade (2) for the same Myanmar sentence
2. Grade (2) is based on Myanmar pronunciation, and this fact caused many ambiguities
3. Formats and prints to Braille transcription rules are not clearly defined yet for writing Myanmar text only in both Grade (1) and Grade (2)
4. Writing or typing orders of Grade (1) and Grade (2) are the same as Myanmar language handwriting order and different from Unicode encoding
5. Grade (2) uses many contractions and abbreviations, which is very difficult for Braille learners.

### IX. CONCLUSION

This paper presents the writing system of Myanmar Braille Grade (1) called Mu Thit and Myanmar Braille Grade (2) called Mu Haung with some examples. My proposal is made on development of DKM keyboard layout for Mu Thit based on existing Myanmar3 Unicode keyboard layout. There is also a plan to make detail analysis on DKM keyboard layout of Mu Thit with users and further update on it and “mmBraille.ttf” font. Six-key entry for Myanmar Braille is to be developed in the near future.

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