

RECOGNITION AND VOICE PRODUCTION OF ONLINE HANDWRITTEN MYANMAR COMPOUND WORDS APPLYING MICR AND MVM SYSTEMS

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KEYWORDS: Myanmar Intelligent Character Recognition (MICR) system, Myanmar Voice Mixer system (MVM) system, Reduce (85%) of original old voice database, ICR, OCR

ABSTRACT: This paper proposes recognition and voice production of handwritten Myanmar Compound words. It is based on Myanmar Intelligent Character Recognition (MICR) system, Myanmar Voice Mixer (MVM) system and voting system. MICR includes statistical and semantics information. To collect information, width and height ratio, black stroke count, number of loops, open directions, histogram values, etc are needed. The final decision is made by the voting system. MVM, a new contribution system divides each vocal sound into two parts: one for basic character sound and the other for shared extended vowel and medial sound. This shared extended vowel and medial sound can also be combined with another basic character sound to produce another meaningful vocal sound. The main idea of MVM is to reduce the original voice database by sharing the same extended vowels and medials. After using MVM system, it reduced the whole old database of all Myanmar compound words (1864) words to (284) words. Consequently, (85%) of voice database is reduced.

1. INTRODUCTION

In the modern centuries, as the standard living of human is rapidly rising, computers are essential using devices for every person. Because the popularity of hand-held computers, digit notebooks and pen-based devices are increasing, the role of character recognition system raises. On the sides of the world, numerous different character recognition methods are used for every language. A character recognition system can be either “**online**” or “**offline**”.

In the online recognition system, the machine recognizes characters which are currently written by the user with tablet, hand-held personal digital assistant (PDA) devices. The online handwriting recognition today has special interest due to increased usage of the hand-held devices. Offline recognition system, on the other hand, is performed after the writing has been performed. There are two types of character recognition in handwritten: one produces voice output and the other produces the editable texts.

There are **two methods** in character recognition: **OCR (Optical Character Recognition)** and **ICR (Intelligent Character Recognition)**. OCR is the process of converting a raster image representation of document into a format that a computer can process. OCR is mostly used in neural network and printed characters. ICR, an advanced of OCR, is the process for converting images of hand-printed characters into machine-readable characters. OCR can recognize only typeface. ICR can overcome OCR’s problems and vice versa. ICR can recognize both typeface and handwritten characters.

Myanmar Languages are derived from Tibet and Mongo languages. In Myanmar, people speak many different languages such as Kachin, Kayar, Karen, Chin, Myanmar, Mon, Rakhine, Shan, etc. However, (32) million people speak Myanmar as a first language. Moreover, people officially use Myanmar Language. **MICR (Myanmar Intelligent Character Recognition)** system is one kind of ICR (Intelligent Character Recognition) methods and it can recognize both online and offline characters. And, it is more convenient for noise free images and isolated characters to improve accuracy rate. Furthermore, MICR was trained and experienced with successfully in both typeface and handwritten characters.

The arrangement of this paper is as follows: Section (2) explains motivation of MVM, Section (3) describes characteristics of Myanmar Language, Section (4) expresses design of the proposed system, Section (5) states MVM system, Section (6) gives experimental results, Section (7) explicates conclusion and further extension and Section (8) explains selected bibliography.




2. MOTIVATION OF MVM (MYANMAR VOICE MIXER) SYSTEM

Around the world, there is a small number of system to recognize and produce the vocal sound to their respective languages. It is slightly hard to produce their respective languages in vocal sound. In Myanmar Language, the newly MVM system has been developed for the production of Myanmar Compound Words in vocal sound as the

extension of MICR (Myanamr Intelligent Character Recognition). However, it has not been produced for all Myanmar Compound Words. Therefore, this paper will extend MVM system for all Myanmar Compound Words by using a few database. These vocal sound output can be helpful to dumb and blind people who cannot talk and see. With this system, they can easily talk the words which they wishes. And then, they can walk the earth reasonably with other people in their whole lives.

Moreover, this system can deeply aid foreigners who want to know Myanmar characters's phonetics. And, they can be easy learning Myanmar Language in short time. MICR can comfortably represent Myanmar Character in unicode and ASCII code but it is nearly hard to represent in vocal sound. When representing all Myanmar Characters's vocal sound in Voice database, these voice database are going to be huge. That is why, in this paper, MVM system can reduce these voice database by mixing the basic characters sound shared with extended vowels and medials sound.

2.1 Prosperous Applications of MICR and MVM System

Prosperous Applications																															
Speed Limited Road Sign Recognition	ရွှေကိုက်(၁၀၀)တွင်ရထားလမ်းရှိသည်။																														
Car License Plate Reader																															
Recognition of Vouchers	<table border="1"> <thead> <tr> <th>Type</th> <th>Total</th> <th>Item</th> <th>Price</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>pencil</td> <td>3</td> <td>300</td> <td>3*300</td> <td>900</td> </tr> <tr> <td>eraser</td> <td>7</td> <td>200</td> <td>7*200</td> <td>1400</td> </tr> <tr> <td>book</td> <td>1</td> <td>1200</td> <td>1*1200</td> <td>1200</td> </tr> <tr> <td>total</td> <td>4</td> <td>350</td> <td>4*350</td> <td>1400</td> </tr> <tr> <td>Total</td> <td></td> <td></td> <td></td> <td>4900</td> </tr> </tbody> </table>	Type	Total	Item	Price	Total	pencil	3	300	3*300	900	eraser	7	200	7*200	1400	book	1	1200	1*1200	1200	total	4	350	4*350	1400	Total				4900
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Digit Recognizer	၀, ၁, ၂, ၃, ၄, ၅, ၆, ၇, ၈, ၉																														
Online Handwritten Myanmar Combined Words Recognition	စာကျက်နေသည်။  စာကျက်နေသည်။																														
Voice production of handwritten Myanmar Compound Words	စာကျက်နေသည်။  စာကျက်နေသည်။																														

3. CHARACTERISTICS OF MYANMAR LANGUAGE

In Myanmar language, there are (33) consonants, (12) vowels and (4) medials. Myanmar characters are written from left to right. They can be written fluently not as difficult as Japan or Korea characters. But they are more complex to write than English characters. Myanmar characters are of round shapes and are identical to each other. That is why, OCR system, Hopfield and back-propagation neural network, may occur error such as misrecognition 'က' with 'ဆ'. ICR can prosperously overcome these difficulties. Myanmar language have basic characters (က, ခ, ဘ, ဓ,.....), extended characters (-, , °, ,.....) and medials (, [, , , ,). They can be seen in Table 1.

Type	Myanmar Character patterns and Digits
Basic Myanmar Consonants	က ခ ဂ ဃ င စ ဆ ဇ ဈ ည ဋ ဌ ဍ ဎ ဏ တ ထ
Basic Myanmar Letters	ဒ ဇ န ပ ဖ ဗ ဘ မ ယ ရ လ ဝ သ ဟ ဋ အ
Vowels	ာ ဝါ ဝိ ဝီ ဝု ဝူ ဝေ ဝဲ ဝံ ဝံ ဝံ ဝံ
Medials	ျ ြ ွ ှ
Digits	၀ ၁ ၂ ၃ ၄ ၅ ၆ ၇ ၈ ၉

Table 1: Myanmar Character patterns and Digits

Some of the basic characters can stand only to produce the meaningful words. They can also be combined with extended characters and medials to become meaningful compound words. The extended characters can come before, after, upper and lower positions of basic characters. Figure 1 shows the terms of character's samples.

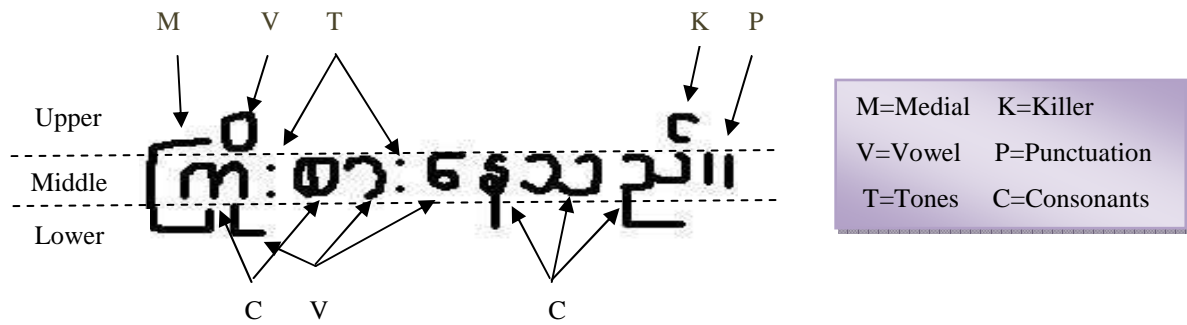


Figure 1: Terms of character's samples

4. DESIGN OF THE PROPOSED SYSTEM

The design of the proposed system includes following five stages: **Image acquisition**, **Preprocessing**, **MICR**, **MVM**, and **Output**. Figure 2 shows design of the proposed system.

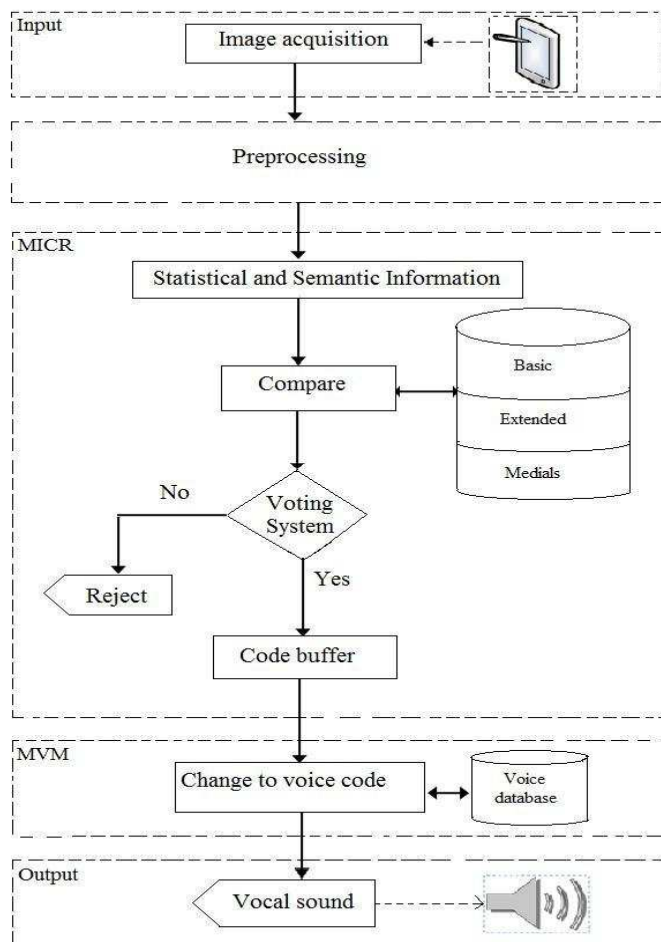


Figure 2: Design of the proposed system

4.1. Image Acquisition and Preprocessing

There are two types of data input; online (or) offline acquired from Tablet (or) Scanner. In online image acquisition, data inputs are stored as images that are concurrently written by the users through Tablet, hand-held PDA (Personal Digital Assistant) devices. In offline image acquisition, data inputs are stored as images that are captured by scanner. Preprocessing covers all those functions carried out prior to the recognition of characters to produce a

cleaned up version of the original image. In this system, the preprocessing unit contains gray scale converting, noise filtering, Binarization, row and column extraction and normalization.

4.2. Myanmar Intelligent Character Recognition (MICR) Engine

MICR system is one kind of ICR (Intelligent Character Recognition) methods and it can recognize both online and offline characters. And, it is more convenient for noise free images and isolated characters to improve accuracy rate. MICR is based on statistical and semantic information which are collected from each character. This information includes the data of width and height ratio, horizontal and vertical black stroke count, number of loops, end point, open direction, histogram values, etc.

After collecting this required information, the incoming character is matched with predefined database which includes basic characters (B database), extended characters (E database) and medials (M database). If the incoming character matches with the predefined database, the voting system produces the relative code number for that character. Otherwise, reject message is produced. If the information of incoming character are not matched from predefined information from the database, these information are trained in the database with their relative codes. Each code includes different information. Same character with different information shows in Table 2. Table 3 explains three types of predefined database.

HW	HC	VC	W:H	Open	Loop	.....
	3	2	≈2	P-7	-	.....
	2	1	≈2	P-7	-	.....
	4	2	≈2	P-7	1	.....

HW=Handwritten
 HC=Horizontal Black stroke count
 VC=Vertical Black stroke count
 W: H=Width and Height ratio
 Open=Open direction
 Loop=Loop position

Predefined database	Handwritten Characters				
Basic Characters (B database)				
				
				
Extended Characters (E database)				
				
				
Medials (M database)				
				
				

Table 2 : Same character with different information

Table 3 : Three types of predefined database

5. MYANMAR VOICE MIXER (MVM) SYSTEM

The idea of this paper is to reduce the original voice database by mixing the basic character sound and the shared extended vowels and medials sound. Therefore, MVM system can be successfully used to reduce these voice database. In this MVM stage, the relative code numbers stored in the code buffer are changed to voice code values and store them in voice code buffer, And then, compare the voice code buffer with the voice code in the predefined voice database. This predefined voice database includes two types of voice database such as basic characters voice database and extended vowels and medials voice database. The vocal sound of each recognized word is produced by mixing the basic character sound and the shared extended vowel and medial sound. This voice output can produce male and female vocal sound.

5.1 The Vowel Modifiers

In Myanmar Language, MVM system divides each vocal sound into two parts : one for basic character sound '၆' and the other for shared extended vowel and medial sound '၇'. This shared extended vowel and medial sound '၇' can also be combined with another basic character sound '၆' to produce another meaningful vocal sound '၈'. Figure 3: shows step by step voice output.

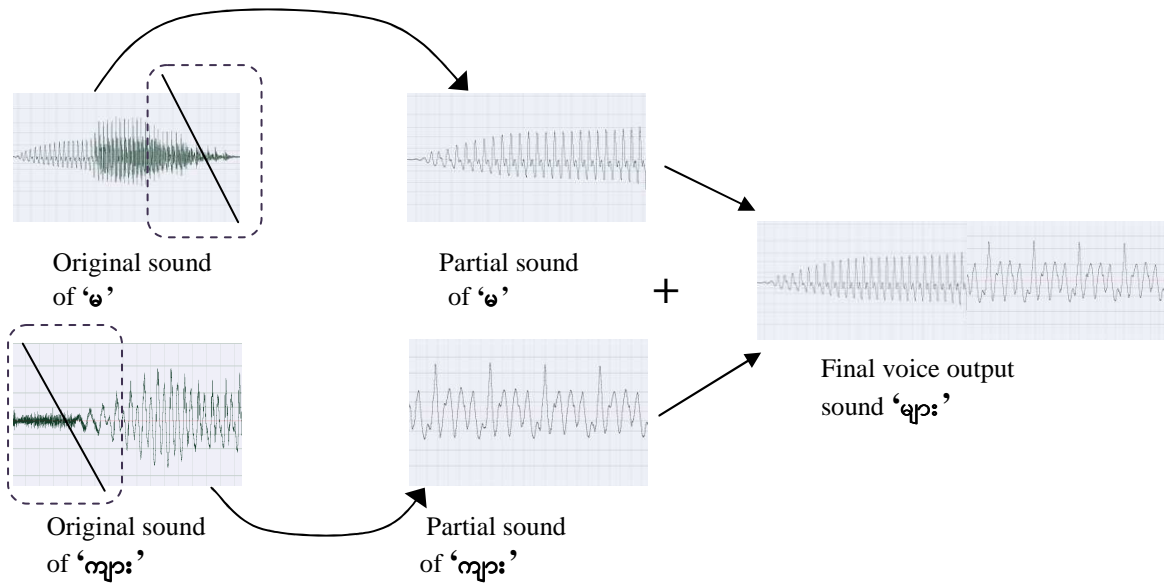


Figure 3: Step by step voice output

5.2 Simplifying Constraints

If the basic character sound ‘က’ combines with another character sound ‘အိုး’, the sound ‘ကအိုး’ can wrongly produce as output. To produce these combined sound correctly, MVM can cut unnecessary parts of sound ‘က’ and ‘အိုး’ to become the output ‘ကိုး’. The basic character sound ‘က’ has numerous ‘အ’ sound in the front and back of that sound’s frequency. Moreover, the another character sound ‘အိုး’ also has many ‘အ’ sound. For that reason, this MVM system cuts these unnecessary ‘အ’ sounds from ‘က’ and ‘အိုး’ and then combines these two correct sound to become the right sound ‘ကိုး’. Myanmar basic character (33) sounds is reduced the similar sounds and finally it remains (21) basic character sounds. Initially, the whole old database of all Myanmar compound words include (1864) sounds. However, after using MVM system, it reduced to (284) sounds. Figure 4: shows original voice database. Figure 5: shows the reduced voice database after applying MVM system.

Basic characters	Extended characters + Medials							
	- ဝ	- ဝး	- ဝ်	- ဝ်း	...	ငံ	ငံး	- ဝ်း
က	ကာ	ကား	ကို	ကိုး	.....	ငံ	ငံး	ကျိုး
ခ	ခာ	ခား	ခို	ခိုး	.....	ငံ	ငံး	ချိုး
.
ဝ	ဝာ	ဝား	ဝို	ဝိုး	.....	ငံ	ငံး	ချိုး
သ	သာ	သား	သို	သိုး	.....	ငံ	ငံး	သျိုး
ဟ	ဟာ	ဟား	ဟို	ဟိုး	.....	ငံ	ငံး	ဟျိုး
အ	အာ	အား	အို	အိုး	.....	ငံ	ငံး	အျိုး
33 voice files	1831 voice files							
Total voice files		(33+1831) 1864 voice files						

Figure 4: The original voice database

Original Vocal sound of Basic characters	Partial vocal sound of basic characters	Original Vocal sound of Vowel ‘ကျား’	Partial Vocal sound of ‘ကျား’	After applying MVM
‘က’				
‘ခ’				
.
.
21 voice files		263 voice files		
Total voice files		(21+263) 284 voice files		

Figure 5: The reduced voice database after applying MVM system

6. EXPERIMENTAL RESULTS

	Voice files of Basic Characters	Voice files of Extended Characters and Medials	Total Voice files	Original and Reduced (%) of voice database	No. of Samples	Average Processing time
Before Modifying database	33	1831	1864	100% original	300 words	70 second
After Modifying by using MVM	21	263	284	85% reduced	300 words	10 second

7. CONCLUSION AND FURTHER EXTENSION

This paper represented the voice production of handwritten Myanmar Compound Words applying MICR (Myanmar Intelligent Character Recognition) and MVM (Myanmar Voice Mixer) systems for all Myanmar Compound Words. MVM system that has been successfully developed in the voice production of handwritten Myanmar Compound Words. Since MICR is based on ICR system, it has few errors than other systems that are based on OCR (Optical Character Recognition) system such as Hopfield and back propagation neural networks, etc. It is more convenient for noise free images and isolated characters to improve accuracy rate. MICR can comfortably represent Myanmar Character in unicode and ASCII code but it is nearly hard to represent in vocal sound. When representing all Myanmar Characters's vocal sound in Voice database, these voice database are going to be huge. So, it is very complicated to represent all Myanmar Characters's vocal sound in voice database. Therefore, this system reduced the voice database by mixing the basic character sound and the shared extended vowel sound and medial sound. In the future, it will recognize the overlap characters for all Myanmar characters and their voice output.

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