The Gong System: Web-Based Learning for Multiple Languages, with Special Support for the Yale Representation of Cantonese

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Abstract. This paper introduces the Gong system, an Internet-based voice board system designed primarily for language learners which includes special support for Cantonese. The Gong system is a client/server design which may be used to complement or, in some contexts, to replace face to face learning. The system supports Unicode input, storage and display of multiple character sets. Furthermore, we have developed a unique storage and display method for the Yale romanized representation of Cantonese, which is the most popular written method used for teaching Cantonese.

1 Introduction

A tool called Gong has been developed that supports Internet-based text and audio communication [1]. It allows students and teachers to participate in discussion groups using their computers. Teachers and students can leave text and voice messages on voice boards. They can listen to and reply to other text and voice messages left by other people. This software is currently used each semester at the author's institution by 300 to 700 undergraduate students, as part of their language course requirements.

2 The Gong System

2.1 Overview

The Gong system is an Internet-based communication tool for language learners. Students and teachers can participate in different discussion boards by reading and writing messages on a board. A message is comprised of a text component and/or a recorded voice component. Fig. 1 shows an example screen display of the system in use by a student. The screen is divided into two parts. The top part shows the message threads of the currently selected discussion board. A user can read or listen to a particular message by selecting the message in the board. The second part contains the content of the selected message. When a message is selected, its text content is displayed in the text area at the bottom while the voice message can be played by using the audio controls. Asynchronous voice discussion on a topic can take place in the board by posting messages in the same message thread.
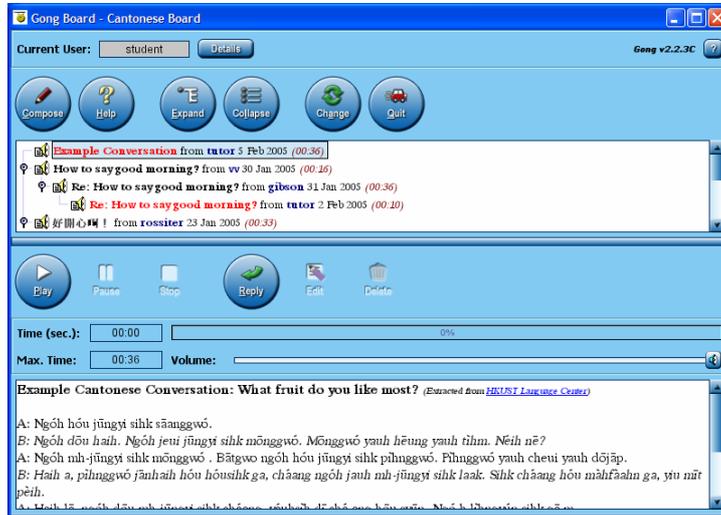
Fig. 1. Screenshot of the Gong system showing a discussion board for a Cantonese course

The Gong system is currently based on a client and server architecture. It is developed using the Java™ technology so that the system is platform-independent. To be able to use the system, students and teachers use client software to connect to a server on the Internet. If they want to read messages on a board, the client software will download the board data from the server. Similarly, if they post a new message on the discussion board the client software will send a request to modify the data in the server. In summary, the server acts as a communication center and centralized store of data.
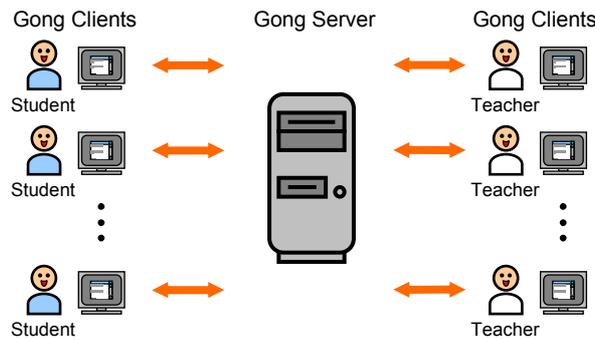

Fig. 2. A basic overview of Gong system usage

2.2 XML Storage and Communication

XML is one type of syntax for expressing data structure. The Gong system has adopted XML as the basis for data storage in the server and also for communication between the clients and the server.
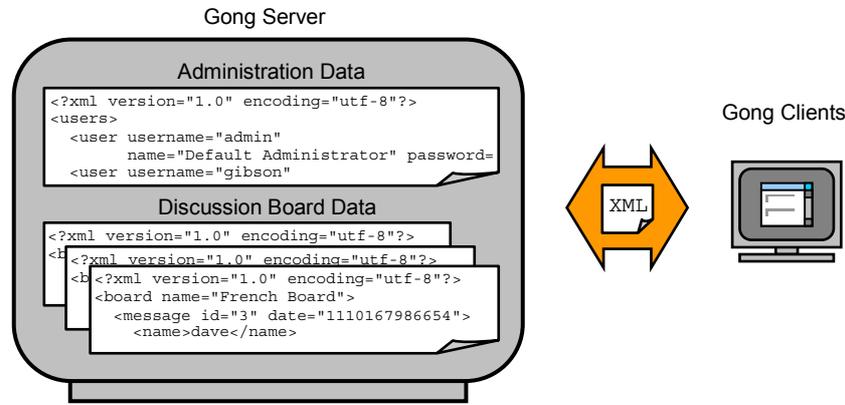
Fig. 3. The XML storage and communication in the Gong system

There are mainly two types of XML data stored in the server. The first type is administration data such as user information, group information and server configuration data. The second one is the content of each discussion board. Each board contains a collection of messages organized in a tree structure.

2.3 Unicode

Unicode [2] is an international encoding standard that provides a unique number for every character, regardless of the platform, program, or language. It has been adopted by the Gong system. This has meant many different languages such as English, Traditional Chinese, Simplified Chinese, French and Japanese can be stored and displayed together.

Although Unicode is able to represent different international languages, it is not specifically designed for displaying romanized languages. A romanized language is an alternative form of a written language which does not use a Latin based alphabet, such as Chinese and Japanese. These types of language are especially important for helping teachers and students in learning the proper pronunciation of foreign languages. Therefore we have created a generic solution for displaying one form of romanized language called the Yale system, with implementation specifically for the Cantonese version of Yale.

3 The Yale Romanization System for Cantonese

3.1 Cantonese

Cantonese is spoken by some 60 million people in many southern parts of China, including the Special Administrative Regions of Hong Kong and Macau. Technically, Cantonese is not a language in itself, but is a dialect of Chinese. However, there are

major differences in pronunciation, lexicon and culture which distinguish Cantonese from other dialects.

Cantonese is a tonal language, meaning that words must be spoken at the right pitch to convey the correct meaning. Essentially, Cantonese uses 6 different tone 'structures' for the pronunciation of a word. There are three tones where the pitch does not vary. There are a further three tones where the pitch does vary. Although it is sometimes said that Cantonese has nine tones, the 'extra' three tones actually use the same pitch as the three unvarying tones described and do not use additional tone patterns.

3.2   The Yale Romanization of Cantonese

The Yale romanization system was developed by Parker Huang and Gerald Kok [3] for learners of Cantonese. The system uses a romanized word together with a marker to indicate the tone which must be used when the word is pronounced.

The romanization of a Cantonese word is generally divided into an initial and a final part. The initial is a combination of one or more consonants. In the Yale system, the initials are restricted to the following set.

- b
- o
- m
- f
- d
- t
- n
- l
- g
- k
- ng
- h
- j
- ch
- s
- y
- w
- gw
- kw

Fig. 4. The nineteen initials of the Cantonese Yale system

A final starts with at least one vowel letter and may end with different choices of consonants. The range of possible finals is shown in Table 1. However, in some cases, the syllable does not have an initial, which means the syllable starts with a vowel instead of a consonant.

Together with the romanization, there are six different Cantonese tones used in the Yale system. When a tone is one of the three low tones an extra h is added after the vowels of a word. This extra h does not affect the pronunciation of the word at all. It is only used as an indicator of a low tone. For example, the Yale representation of the low level tone of the word lei is leih. Some of the tones are further distinguished by adding a diacritic mark on the first vowel of the word. A diacritic is a mark drawn above a vowel letter to indicate special phonetic information. Diacritics are added to denote a specific tone pattern for several of the Yale tones. The following table shows tones together with their corresponding romanized form in the Yale system.

Table 1. The fifty three finals of the Cantonese Yale system

| Vowel Base	Finals	Vowel Base	Finals	Vowel Base	Finals
aa	• aai	a	• a	e	• e
	• aau		• ai		• ei
	• aam		• au		• eng
	• aan		• am		• ek
	• aang		• an		
	• aap		• ang		
	• aat		• ap		
	• aak		• at		
			• ak		
i	• i	o	• o	u	• u
	• iu		• oi		• ui
	• im		• ou		• un
	• in		• on		• ung
	• ing		• ong		• ut
	• ip		• ot		• uk
	• it		• ok		
	• ik				
eu	• eu	ü	• yu	nasal sound	• m
	• eui		• yun		• ng
	• eun		• yut		
	• eung				
	• eut				
	• euk				

Table 2. The Yale representation of the six Cantonese tones

Tone Number	Tone Description	Yale Example	Cantonese Example
1	High Level	wāi	威 (powerful)
2	High Rising	wái	毀 (destroy)
3	Middle Level	wai	慰 (comfort)
4	Low Falling	wàih	唯 (only)
5	Low Rising	wáih	偉 (great)
6	Low Level	waih	胃 (stomach)

4   The XML Extension for the Yale Romanization System

4.1   Representation of Yale Romanization in XML

An XML representation is proposed for the Yale romanization system. We use two XML tags to denote a structural representation for Cantonese sentence. The first tag,

Cantonese Sentence with
Yale Representation:

Structural Representation:

Sentence Level
(<yale> tag)

gwóng dūng wá
廣　東　話

Word Level
(<word> tag)
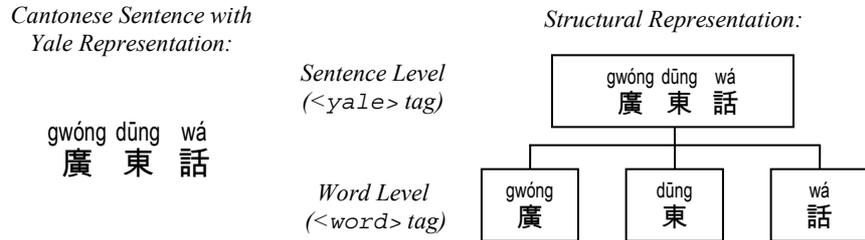
Fig. 5. An example of the structural breakdown of a Cantonese sentence using the XML tags

<yale>, is used to enclose a sentence which represents Yale romanizations of this sentence. Inside the <yale> tag we further divide the sentence into separate Cantonese words by putting each word into a <word> tag. An example is shown in Fig. 5.

We have not implemented a complete grammatical representation because the romanized form of a Cantonese sentence typically has a wide range of possible interpretations.

Other Languages Using the Yale System. Cantonese is not the only language which employs some form of Yale romanization. There are also representations of Japanese, Korean and Mandarin which use a Yale system. To distinguish between these we have defined a lang attribute. By reference to the RFC3066 standard [4] and the Internet Assigned Numbers Authority [5], we use a language code of zh-yue to indicate the Cantonese system. The corresponding language code for Japanese, Korean and Mandarin are ja, ko and zh-guoyu respectively. The lang attribute of the <yale> tag is used to specify which one is being used.

The Tone Numbering System. We have created a tone attribute in the <word> tag so that each word can be associated with the correct tone. We start with six tones in the Yale system. To distinguish between the tones we can make use of tone numbers one to six to represent the tones. However, some variations of the Cantonese Yale system include three or four more tones. Specifically, these include short instantiations of the high level tone, middle level tone and low level tone as well as a high-falling tone. When these are used they are called tones although in the case of the latter three they actually share the same tone structure of tones one, three and six. The high-falling tone is now commonly pronounced as a high-level tone in Cantonese although there are a few exceptions. We use tone zero to represent a high-falling tone and tones seven, eight and nine to represent the three short instantiations. In summary, Table 3 shows the tone numbering system we have adopted.

Combining the XML tags and attributes, we form a general representation of a Cantonese sentence. Two examples are shown in Fig. 6.

4.2 Validation with XML Schema

In order to ensure the correctness of the XML content being stored we have defined an XML Schema. This XML schema not only describes the structural information of the Yale XML but also validates the correctness of the Yale Cantonese words.

Table 3. The tone numbering system used in the Gong system

Tone Number	Name	Tone	XML Example using `lei`
0	High Falling	⟍	`<word tone="0">lei</word>`
1	High Level	—	`<word tone="1">lei</word>`
2	High Rising	⟋	`<word tone="2">lei</word>`
3	Middle Level	—	`<word tone="3">lei</word>`
4	Low Falling	⟍	`<word tone="4">lei</word>`
5	Low Rising	⟋	`<word tone="5">lei</word>`
6	Low Level	—	`<word tone="6">lei</word>`
7	Short Instantiation - High Level	—	`<word tone="7">lei</word>`
8	Short Instantiation - Middle Level	—	`<word tone="8">lei</word>`
9	Short Instantiation - Low Level	—	`<word tone="9">lei</word>`

Cantonese Sentence with Yale Representation:　　　*XML Representation of the Sentence:*

gwóng dūng wá
廣　東　話

```
<yale lang="zh-yue">
  <word tone="2">gwong</word>
  <word tone="1">dung</word>
  <word tone="2">wa</word>
</yale>
```

leíh sihk   jó faahn meih a
你　食　咗　飯　未　呀

```
<yale lang="zh-yue">
  <word tone="5">lei</word>
  <word tone="6">sik</word>
  <word tone="2">jo</word>
  <word tone="6">faan</word>
  <word tone="6">mei</word>
  <word tone="3">a</word>
</yale>
```
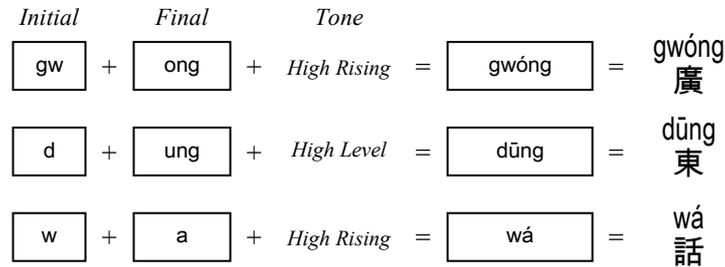
Fig. 6. Two examples of XML representation of a Cantonese sentence

The schema validates a Cantonese word by breaking it down into three separate parts: the initial, the final and the tone. Fig. 7 shows three examples. The full listing of the XML Schema used to validate the Yale representation of Cantonese can be found in Appendix A.

Initial		Final		Tone			
gw	+	ong	+	*High Rising*	=	gwóng	= gwóng 廣
d	+	ung	+	*High Level*	=	dūng	= dūng 東
w	+	a	+	*High Rising*	=	wá	= wá 話

Fig. 7. The combination of initial, final and tone to define Cantonese words in Yale representation

4.3 Visual Presentation of the Yale XML Extension

XSL Transformations of the XML Extension. An XSL transformation is one of the most common methods used for the visualization of XML data. We have created an XSL stylesheet so that the Yale XML extension can be viewed in the form of a Scalable Vector Graphics (SVG) document. SVG is an XML language for describing two-dimensional graphics. Fig. 8 shows an example Cantonese sentence together with the resulting SVG display. The XSL stylesheet used can be found in Appendix B.

XML Representation of the Sentence: *The SVG visualization:*

```
<yale lang="zh-yue">
  <word tone="4">yan</word>
  <word tone="6">dei</word>
  <word tone="3">pa</word>
  <word tone="2">chau</word>
  <word tone="1">a</word>
  <word tone="3">ma</word>
</yale>
```

```
yāhn
deih
pa
chāu
ā
ma
```

Fig. 8. An example of the visualization of a Cantonese sentence using XSL transformations. The visualization takes the form of an SVG document

Visual Presentation in the Gong System. The Gong system supports the Yale diacritic display and a specially designed stronger depiction of the diacritic display. We have added this visually 'stronger' display because the display of diacritics on different systems is often weak and inconsistent in appearance. We have also adopted a numbering display system for the Yale representation. This display system adds the tone number to the end of a Cantonese word according to the tone numbering system shown in Table 3.

There are three display modes in the Gong system. They are *Tones with Lines*, *Tones with Diacritics* and *Tones with Numbers* as shown in Fig. 9. An example of each is shown in Table 4.

Fig. 9. An example of Yale representation using discrete lines in the Gong system. There are three choices for the display method of the Cantonese words, as shown in the selection box

Table 4. A Cantonese sentence displayed using three different modes in the Gong system

Mode	Cantonese Example
Tones with Lines	yàhn deih pa cháu ā ma
Tones with Diacritics	yàhn deih pa cháu ā ma
Tones with Numbers	yan4 dei6 pa3 chau2 a1 ma3

4.4 Input System for the Yale Romanization in the Gong System

In the Gong system seven buttons are provided to assign a tone to a particular Cantonese word. Visually, we try to help the users in identifying the tone by showing the corresponding tone levels on the buttons. Fig. 10 shows these buttons in the Gong system.

Fig. 10. The input system of the Cantonese Yale representation in the Gong system. The buttons use an image of the corresponding tonal representation

With these buttons a user can input a Cantonese word by first typing in the romanized form of the word, selecting the word and then clicking on one of the buttons representing the desired tone.

5   Conclusion

We have developed a web-based educational tool called Gong. This system is primarily designed for language learning. Students and teachers can participate in discussion groups through the use of the Internet. By using Unicode as the encoding scheme the system can support all major languages in the world. This makes the system suitable for courses of different languages. However, to have better support for Cantonese courses we have added an XML extension for the Yale romanization system. With the use of this XML extension the system is capable of storage and display of the Yale representation of Cantonese sentences which is very helpful for Cantonese learners.

Acknowledgements

References

1. The Gong Project, http://www.cs.ust.hk/gong
2. Unicode, http://www.unicode.org/
3. Huang, P. Kok, G.: Speak Cantonese sounds, vols 1-3., Newhaven Yale University Press, 1970.
4. Alvestrand, H.: Tags for the Identification of Languages, RFC 3066, BCP 47, January 2001, http://rfc.net/rfc3066.html
5. Internet Assigned Numbers Authority, http://www.iana.org/

Appendix A   The XML Schema for the Yale Representation

```xml
<?xml version="1.0" encoding="utf-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:simpleType name="tonetype">
    <xs:restriction base="xs:integer">
      <xs:minInclusive value="0"/>
      <xs:maxInclusive value="9"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="syllable">
    <xs:restriction base="xs:string">
      <xs:pattern
        value="(b|p|m|f|d|t|n|l|g|k|ng|h|j|ch|s|y|w|
                gw|kw)?
               (aai|aau|aam|aan|aang|aap|aat|aak|
                a|ai|au|am|an|ang|ap|at|ak|
                e|ei|eng|ek|
                i|iu|im|in|ing|ip|it|ik|
                o|oi|ou|on|ong|ot|ok|
                u|ui|un|ung|ut|uk|
                eu|eui|eun|eung|eut|euk|
                yu|yun|yut|m|ng)"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:complexType name="wordtype" mixed="true">
    <xs:simpleContent>
      <xs:extension base="syllable">
        <xs:attribute name="tone" type="tonetype"
                      use="required"/>
      </xs:extension>
    </xs:simpleContent>
  </xs:complexType>
  <xs:element name="word" type="wordtype"/>
  <xs:complexType name="yaletype" mixed="true">
    <xs:sequence>
      <xs:element ref="word" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:attribute name="lang" type="xs:string"
                  fixed="zh-yue" use="required"/>
  </xs:complexType>
  <xs:element name="yale" type="yaletype"/>
</xs:schema>
```

Note: The regular expression shown above is broken into separate lines to improve the ease of viewing. It is a single line in the original document.

Appendix B   The XSL Transformation File for the Conversion of Cantonese Yale XML into SVG

```xml
<?xml version="1.0" encoding="utf-8"?>
<xsl:transform xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
               version="1.0">
  <xsl:output indent="yes"/>
  <xsl:template match="yale[@lang='zh-yue']">
    <svg width="640px" height="480px"
         style="font-family: Courier New; font-size: 25">
      <xsl:for-each select="word">
        <xsl:variable name="initial"
          select="replace(., '[a|e|i|o|u].*', '')"/>
        <xsl:variable name="final"
          select="replace(., '^[^a|^e|^i|^o|^u]+', '')"/>
        <xsl:variable name="vowels"
          select="replace($final, '^([a|e|i|o|u]+).*', '$1')"/>
        <xsl:variable name="consonants"
          select="replace($final, '^([a|e|i|o|u]+)', '')"/>
        <xsl:element name="g">
          <xsl:attribute name="transform"
            select="'translate(10,',position()*30,')'"/>
          <text>
            <xsl:value-of select="$initial"/>
            <xsl:value-of select="$vowels"/>
            <xsl:choose>
              <xsl:when
                test="@tone='4' or @tone='5' or @tone='6'">
                h
              </xsl:when>
            </xsl:choose>
            <xsl:value-of select="$consonants"/>
          </text>
          <xsl:element name="g">
            <xsl:attribute name="transform"
              select="'translate(',
                      string-length($initial)*15+1,',-17)'"/>
            <xsl:choose>
              <xsl:when test="@tone='1'">
                <rect width="14" height="4" style="fill: white"/>
                <line x2="13" y1="2" y2="2" style="stroke: black"/>
              </xsl:when>
              <xsl:when test="@tone='0' or @tone='4'">
                <rect width="14" height="4" style="fill: white"/>
                <line x2="13" y1="1" y2="3" style="stroke: black"/>
              </xsl:when>
              <xsl:when test="@tone='2' or @tone='5'">
                <rect width="14" height="4" style="fill: white"/>
                <line x2="13" y1="3" y2="1" style="stroke: black"/>
              </xsl:when>
            </xsl:choose>
          </xsl:element>
        </xsl:element>
      </xsl:for-each>
    </svg>
  </xsl:template>
</xsl:transform>
```