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***Research paperv***

# Visual Design for Malay Consonants Pronunciation

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**Abstract**

Numerous studies on text visualization have been long conducted around the world for distant and close reading. Nevertheless, in Malay language, a lot of research works on text visualization are focusing more on distant reading as compared to close reading. Thus, there is still lacking on determining textual feature for in-depth analysis of Malay texts. This paper discusses the Malay texts features that involve in designing the pronunciation of Malay consonants. The design process starts by analyzing articulation table and the standard articulation part of human mouth. The important parameters are identified from both sources in order to represent such data and symbols in a glyph visualization. Each glyph representation illustrates the simplified version of pronouncing the consonants. This research gives benefit to scholars who learn Malay language as a second language, specifically concentrating on pronouncing a precise Malay consonant.

***Keywords:*** *Consonant, Glyph, Malay texts, Phonetic, Pronunciation.*

## 1. Introduction

In the recent years, there has been an increasing amount of research on text visualization. The power of visualization helps people to see things in new perpectives by creating and discovering hidden ideas or knowledge, detecting patterns, finding abstractions and communicating ideas *(Lyding and Culy 2012)*. There are a lot of studies of text visualization across multi-platform of application domains and languages. For example, Kucher and Kerren *(2015)* conducted visual survey of several visualization techniques in displaying the outcomes of visualization.

Malay language is one of the languages that is also in text visualization research. Research on Malay texts visualization involves studies of different purposes. For instance, Malay texts are used in information retrieval *(Idris & Syed Mustapha 2001, Abu Bakar & Abdul Rahman 2003, Abdullah 2006, Sembok 2007, Ismail et al. 2013, Rahman et al. 2015)*, classification *(Nong et al. 2001, Jamal et al. 2012, Yaman 2013, Saloot et al. 2016)*, speech synthesis *(El-Imam & Don 2000, Samsudin et al. 2004, Hafiz et al. 2011, Seman 2014)*, semantic similarity measures *(Noah et al. 2007)*, sentence parser *(Ahmad et al. 2007, Kasbon et al. 2011, Muhamad Noor & Jamaludin 2012)*, stemmer *(Abu Bakar & Abdul Rahman 2003, Lee et al. 2013)* and many more. The data comprise of various sources such as news bulletin, hadiths, local newspapers, Malay translated al-Quran, novel, and Malay dictionary.

Malay language has features that include sound, word, and grammar. Sound is part of phonetic studies, in which the knowledge of phonetic elements is important in word pronunciation. Phonetic uses special signs to represent different sounds in speech. These phonetic features can be represented to users, who are usually learners, for understanding letters and words interactively via computerized system.

However, to date, there is lack of research on the Malay texts visualization that focusing specifically on the visualization of sound pronunciation. There are several research works on sound visualization in English language. For examples, McCurdy *et al. (2016)* created a visualization tool to visualize the sonic topology of a poem interactively. Benner *(2014)* employed computational techniques for analyzing sound play in a corpus. Coles and Lien *(2013)* created a digital poetry visualization tools with sonic patterns. Chaturvedi *et al. (2012)* developed a visualization tool to analyze different features of texts in a poem such as sound, syntax and rhythm, that are integrated to create meaning. Abdul-Rahman *et al. (2013)* created poem viewer for visualizing poem elements including consonants, vowels, assonance, alliteration, rhyme, and semantic relations.

Therefore, the aim of this study is to visualize the pronunciation of Malay consonants. Through this research, the design of consonant pronunciation is constructed. The findings of this study will help speakers to pronounce the words correctly.

## 2. Design Process

Figure 1 shows the flow of process for this research. There are three main phases: pre-processing; visual design; and evaluation. In pre-processing phase, data texts are collected from a particular domain (in this case is a Malay pantun) and such data texts are transformed into a transcription form, manually.

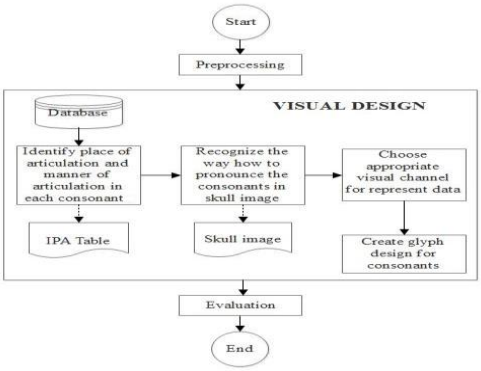



**Figure 1**. Design process

The second phase is the visual design for consonants, which is the main focus of this work. Visual design is the most critical part in the design process because visual representation allows users to process information quickly and efficiently. The visual design process starts by identifying place of articulation that involves in pronounciation. This identification is based on Malay IPA table *(Abdullah 2009)* as shown in Table 1. The place of articulation in IPA table basically based on human speech organ as illustrated in Figure 2. Generally, the sound is generated from the air released from the lungs towards the articulation parts in the mouth. The reaction and movement of the articulation part such as lips, soft palate, hard palate and tongue to this air will produce certain sounds.

**Table 1.** A Standard Malay consonant system

| Manner of Articulation | | Place of Articulation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Bilabial** | **Labio-dental** | **Dental** | **Alveolar** | **Postal-veolar** | **Palatal** | **Velar** | **Pharyngeal** | **Glottal** |
| Plosive | Voiceless | **P** | | | **t** | | | **k** | | **ʔ** |
| | Voiced | **b** | | | **d** | | | **g** | | |
| Nasal | | **m** | | | **n** | | **ɲ** | **ŋ** | | |
| Trill | | | | | **r** | | | | | |
| Tap or Flap | | | | | | | | | | |
| Fricative | Voiceless | | **f** | | | **s** | **š** | □ | | **h** |
| | Voiced | | **v** | | | **z** | | **γ** | | |
| Affricate | Voiceless | | | | | | **c** | | | |
| | Voiced | | | | | | **j** | | | |
| Approximant | | **w** | | | | | **y** | | | |
| Lateral | | | | | **l** | | | | | |
| | | | | | | | | | | |

Malay language has 26 Latin alphabets including nineteen primary consonants (native consonant sounds) and eight secondary consonants which are Malay words adopted from other languages; heavily based on English and Arabic. In addition, standard Malay has six vowels, which are based on the place of artic
ulation (front, central and back) and the position of a tongue (high, mid and low). Furthermore, Malay language has three native diphthongs which are 'ai', 'au' and 'oi'. The consonants and vowels have different ways of discourse depending on the articulation parts, airflow and also the position of the tongue.

The articulation position is very important to be identified and analyzed based on skull images *(Zahid & Omar 2006)* which describe the pronouncing of consonant visually. Nevertheless, the skull image is hard to draw and remember, due to its complex structure as shown in Figure 2.

Therefore, visual channels are chosen to represent the articulation. Examples of visual channels are color, shape, orientation, and size *(Iliinsky & Steele 2011)*. Shapes and colors are adequate to be selected in this study.

Table 2 illustrates a few examples of the visual channel, which are strictly based on integrating and mapping of the articulation part in human mouth and a standard Malay consonant. Referring to Figure 2, the bilabial is marked as red color and circle shape. A circle is a simple symbol that can represent similar objects of different characteristics.

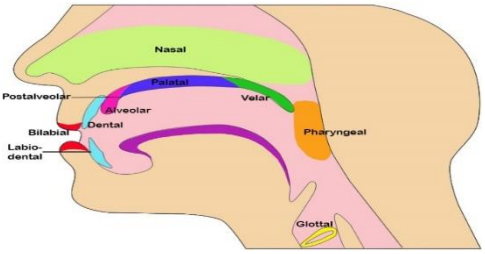
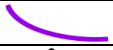



**Figure 2.** Articulation part in human mouth

The last steps in visual design phase is to encode the visual design of Malay consonants using glyph. Glyph is a visual representation of a piece of data where the attributes of a graphical entity are dictated by one or more attributes of a data record. In this study, glyph is used to represent the place of articulation in the mouth such as mouth, lips, teeth, vocal cords, and velar.

**Table 2.** The glyph design representing articulation part and visual channel

| ***Articulation part*** | ***Visual channel*** |
|---|---|
|  | *Open lips* |
|  | *Close lips* |
|  | *Alveolar* |
|  | *Palatal* |
|  | *Velar* |
|  | *Pharyngeal* |
|  | *Teeth* |
|  | *Vocal cord - open* |
|  | *Vocal cord - vibrate* |
|  | *Rest tongue* |
|  | *Tip front tongue rise* |
|  | *Voice* |

In Figure 3, the glyphs for consonant p and b are demonstrated. The design is presented in details on pronouncing the consonants.

Every path in the mouth that involves in sound production is drawn to illustrate to users on pronouncing the letters correctly. The consonant p and b are paired together because they present the same mouth position to pronounce these phones. In order to produce the sound of phone p and b, the lips are closed, and soft palate is raised and close to throat cavity. They have a stop or plosive consonant sound, which is the sound made by building up air pressure on stopping air flow by the lips and then releasing it through the mouth. However, they are different in the context of voice and voiceless. The consonant p is voiceless, which means vocal cords is not use to make the sound. The consonant b is voice, where the vocal cords is vibrating, and the air stream is released in the manner of a mini-explosion.

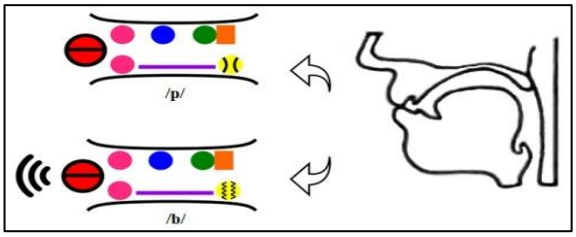



**Figure 3.** Visual design for consonant p and b

Similar to consonant p and b, the consonant t and d are paired together because they are also take the same mouth position to produce the sound as shown in Figure 4. For the phoneme t and d, the lips are open and soft palate is raised and close to throat cavity. The tongue arises and the front part touches the roof of the mouth just behind the top front teeth.

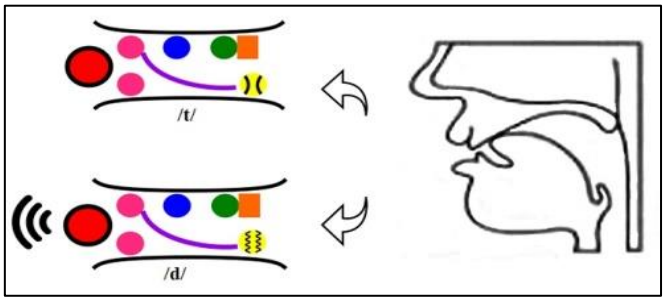



**Figure 4.** Visual design for consonant t and d

The tongue's position presses against the roof of the mouth to stop the airflow before releasing the air. Then, the tongue pulls down to release the air. The teeth are together when this happens. The consonant t is voiceless, which means vocal cords is not use to make the sound. The consonant d is voice, where the vocal cords is vibrated and the air stream is released in the manner of a mini-explosion.

There are some differences and similarities between consonant design p, b, t and d. The articulation parts involved in designing these consonants are similar. Since these four consonants are the plosive, the velar part is closed to the pharyngeal part to prevent airflow from entering the nasal area. This airflow passes through the mouth area before being released for the production of plosive consonants. However, there is a difference in the position of tongue for the production of these consonants. The tongue position of consonant p and b is in rest while it is raised upwards for the consonant t and d. Consonant b and d are voice where vocal cord are vibrated. Meanwhile, consonant p and t are voiceless and vocal cord are opened. Table 3 shows the summary of differences and similarity of these consonants' attributes.

**Table 3.** Differences and similarity of consonants' attributes

| ***Consonant*** | ***Differences*** | | | | ***Similarity*** |
|---|---|---|---|---|---|
| ***p*** | *Vocal cord open* | | *Rest tongue and close lips* | | |
| ***b*** | *Voice and vocal cord vibrate* | | | | |
| ***t*** | *Vocal cord open* | | *Tongue rise and open lips* | | |
| ***d*** | *Voice and vocal cord vibrate* | | | | |

After the visual design phase is completed, it is important to have the evaluation for the proposed design. The purpose of this phase is to ensure that the visual design has met its functionality by providing the proper symbols, which can be understood to guide people in order to pronounce the necessary consonants.

## 3. Evaluation

The study of sound requires a general knowledge in linguistic fields. Hence, the evaluation of the visual design is conducted by five linguistic experts who have various experience in the phonetic field. The evaluation is carried out via face to face interviews. Each evaluation starts with the explanation on the background of this study. Then, all of the consonants' design are given to the experts for observation and assessment. The evaluation is guided by five subjective form of questions relating to design functionality, user understanding and design representation. One of the questions is an open-ended type that allows the experts to express more thoughts and discussions around the design. The evaluators are given opportunity to give any judgement and suggestions related to the consonants' visual design. During the interview, the discussions are recorded for further detail analyses.

Based on the qualitative answers, all experts are strongly agree with the visual design. They express that the design is very appropriate and helpful for pronouncing the Malay consonants in a precise way. Besides, the proposed designs are able to show the clear distinction among the consonant letters. The chosen symbols and colors are also accepted for their appropriateness and interesting signatures. One of the experts really appreciates this visual design due to some of his students in linguistic course face the problem to master in drawing the diagram of human mouth that represents the articulation. With this visual design, it really helpful to simplify the drawing process.

In summary, the evaluation process is succesful with positive feedbacks from the evaluators. These visual designs are

professionally accepted for the next phase of our research work. Generally, this evalution helps to improve the effectiveness and functionality of the visual design study.

## 4. Conclusion

This study has shown that the visual analysis is important to support external memorization of learning pronunciation of Malay consonant. Every part in the mouth that involves in producing sound is visualized by using glyph design. The visualization of phonetic symbols help people, especially the new learners, to pronounce the Malay words in a better way without using imagination. Nevertheless, there are a few native Malays do not speak the standard Malay because there are many different Malay slangs in most parts of the country. Besides, some people have difficulties in pronouncing the r and l sounds that exist in some languages in the world. Pronounciation can be handled with practices because the inventory of sound for a language is limited to a subset of the sounds that the human mouth can make. Hence, the visualization of this sound pronunciation is among the best way to help people practising the correct way of pronouncing letters and words.

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