Building a Spoonerism Detection System for Vietnamese

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Abstract

This paper presents the first automatic system for Vietnamese spoonerism detection. By incorporating hand-crafted rules with Vietnamese language model, our system, although simple, achieves a promising result for this task. The proposed method achieves an overall F_1 score of 95.47% on the Vietnamese spoonerism dataset.

1 Introduction

Spoonerism is a linguistic phenomenon in which parts of two spoken words including consonants, vowels, and tones can be switched to construct two other implied words. A term spoonerism is named after William Archibald Spooner, who was famous for making spoonerism. Spoonerism can be seen as one kind of wordplay used to entertain or to criticize. People often use spoonerism in both of written form such as poetry and in oral form such as music and folk tale. To make spoonerism, they use several rules switching parts of one word to the other word to form words with implied meaning. Figure 1 shows a well-known example of spoonerism in English.

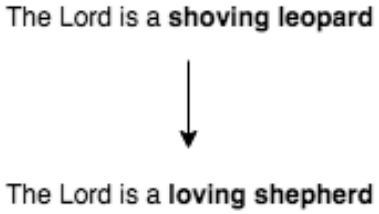

Figure 1: Spoonerism in English

Spoonerism in Vietnamese has a long history. It is found in Vietnamese poetry from the 17^{th} century and in traditional folk tale and song. Speaker often uses spoonerism in mocking or sarcasm contexts where directness is avoided. They also use spoonerism as a linguistic challenge in riddles and parallel sentences. Vietnamese, because of its linguistic characteristics, is very suitable for making spoonerism. People only need to switch parts of surface words to form meaningful Vietnamese words. For this reason, spoonerism is used widely in practice by Vietnamese people.

Spoonerism detection is an important step used in some natural language processing applications such as question answering and sentiment analysis. It provides useful information that helps computers understand human conversation more deeply. However, to best of our knowledge, there is no research on building an automatic system for spoonerism detection.

In this paper, we present the first spoonerism detection system for Vietnamese language that uses hand-crafted rules associated with Vietnamese language model. Our system, although simple, achieves promising results for this task. In particular, our system obtains an F_1 score of 95.47% on Vietnamese spoonerism dataset. Moreover, our approach does not require the training data when collecting data for this task is difficult. We also publicize our Vietnamese spoonerism detection system and Vietnamese spoonerism dataset for research purpose, which is believed to positively contributing to the long-term advancement of Vietnamese language processing[1].

[1] https://github.com/khoaipx/Vietnamese-Spoonerism

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Input: Vietnamese sentence
Output: Type 1 and Type 2 spoonerisms
Step 1: Extract syllable pair set from input sentence;
Step 2: **for** *each syllable pairs* **do**
  Decompose syllables pair;
  Generate reverse forms by using spoonerism rules;
  for *each reverse form* **do**
    Compare with other syllable pairs;
    if *matched* **then**
      Move these pairs from syllable pair set to Type 2 candidate set;
  end
end
Step 3: Resolve Type 2 conflict;
Step 4: Select syllable pairs that do not overlap with syllables in Type 2 set;
Step 5: **for** *each syllable pairs* **do**
  for *each reverse form* **do**
    Use language model, dictionary to find the reverse form with highest score;
    if *score* > *threshold* **then**
      Move this pair to Type 1 candidate set;
  end
end
Step 6: Resolve Type 1 conflict;

Algorithm 1: Vietname Spoonerism Detection

The remainder of this paper is structured as follows. Section 2 presents Vietnamese characteristics including vowel, consonant, and tone, the history of using spoonerism in Vietnamese, and rules for making Vietnamese spoonerism. Section 3 describes our spoonerism detection system for Vietnamese. Section 4 gives experimental results and discussions. Finally, Section 5 concludes the paper.

2 Background

2.1 Vietnamese Language Characteristics

Vietnamese is a Mon-Khmer language spoken by more than 100 million people. It is the official and national language in Vietnam. There are three main dialects of Vietnamese: the northern (used in national broadcast in Vietnam), the central, and the southern dialects. Vietnamese words are formed from one, two, or more syllables and syllables are separated by spaces. Phonologically, each syllable is a combination of initial and final consonants (optional), vowel, and tone. The details of each component of Vietnamese syllables are described as follows.

Vowel Vietnamese has comparative large numbers of vowels (monophthongs), diphthongs, and triphthongs. They are given in table 1 below.

	Front	Back	Center
Centering	ia, iê, iêu	ưa, ươ, ươu, ươi	ua, uô, uôi
Close	i, iu	ư, ưu, ưi	u, ui
Mid	ê, êu	ơ, â, âu, ơi, ây	ô, ôi
Open	e, eo	a, ă, ao, au, ai, ay	o, oi

Table 1: Vowels, diphthongs, and triphthongs in Vietnamese

Consonant Vietnamese consonant is written with one or two characters. It can appear at the begining or the end of the Vietnamese syllable. Vietnamese consonants are given in table 2 below.

		Labial	Alveolar	Retroflex	Palatal	Velar	Glottal
Nasal		m	n		nh	ng/ngh	
Stop	Tenuis	p	t	tr	ch	c/k/q	
	Glottalized	b	đ				
	Aspirated		th			kh	
Fricative	Voiceless	ph	x	s			h
	Voiced	v	d	r	gi	g/gh	
Approximant		u/o	l		y/i		

Table 2: Consonants in Vietnamese

Tone Each Vietnamese syllable has its own tone. The tone is marked at the vowel of the syllable. They are given in table 3 below.

Name	Description	Mark	Example
ngang	mid level	no mark	a
sắc	high rising	/	á
huyền	low falling	\	à
hỏi	mid dipping-rising	?	ả
ngã	high breaking-rising	~	ã
nặng	low falling constricted	.	ạ

Table 3: Tones in Vietnamese

2.2 Spoonerism in Vietnamese

Spoonerism in Vietnamese has a difference compared to other languages. It occurs between two syllables instead of two words. Moreover, Vietnamese

has two important characteristics that make it suitable for spoonerism. First, the boundary between the syllables is very clear. Second, almost consonants can be combined with vowels and tones to make meaningful syllables (Le and Ho, 2013). For these reasons, Vietnamese spoonerism has been used widely in both of written and oral form hundreds of years ago.

In Vietnamese literature, spoonerism is used mainly in poetry. Ho Xuan Huong, the female poet who lived in the eighteenth century, is one of the most well-known Vietnamese poets using spoonerism in their works. She used spoonerism as an art form to express her opinions about the status of women, male authority, Buddhist practices, and the social order of her times (Macken and Nguyen, 2006; Nguyen, 2010a; Le, 2011). Figure 2 shows an example of using spoonerism in Ho Xuan Huong's poem, the English translation is from (Macken and Nguyen, 2006).

Vietnamese Poem	Vịnh kiếp tu hành Cái kiếp tu hành nặng **đá đeo** Vị gì một chút tẻo tèo teo Thuyền từ cũng muốn về Tây Trúc **Trái gió** cho nên phải **lộn lèo**		
English Meaning	Like of a monk The life of a monk is as heavy as carrying stone Who cares about the little things The boat of religion would want to go to Buddha's home But the adverse wind came, and the halyard was entangled		
Vietnamese Word	đá đeo	→	đéo đa
English Meaning	carry stone		not much (vulgar style)
Vietnamese Word	trái gió	→	chó giái
English Meaning	adverse wind		dog's testicle
Vietnamese Word	lộn lèo	→	lẹo lồn
English Meaning	entangled halyard		copulating vagina

Figure 2: Spoonerism in Ho Xuan Huong's poem

In oral form such as classic folk tales and folk songs, spoonerism is often used to entertain or to criticize (Mai, 2010; Nguyen, 2010b; Bui, 2011; Tran, 2011; Le, 2012). Figure 3 shows examples of using spoonerism in oral speech form (Vu, 2016), the English translation is from (Macken and Nguyen, 2006).

Vietnamese Sentence	Trên trời rớt xuống mà lại **mau co**		
English Meaning	What falls from the sky andis quick to curl?		
Vietnamese Word	mau co	→	mo cau
English Meaning	quick curl		leaf stem areca

(a) A riddle

Vietnamese Folk Song	Con **cá đối** nằm trên cái **cối đá** Con chim đa đa đậu nhánh lá đa Chồng gần sao em không lấy mà em đi lấy chồng xa Lỡ mai mẹ yếu cha già Bát cơm, chén nước, chén trà ai dâng?		
English Meaning	The "doi" fish lies on the stone mortar The "da da" bird clings on the banyan twig A husband near your home, why don't you marry Tomorrow when your Mom is weak, your Dad is old A bowl of rice, a glass of water, a cup of tea - who is going to offer them to your Mom and Dad?		
Vietnamese Word	cá đối	→	cối đá
English Meaning	"doi" fish		stone mortar

(b) A folk song

Vietnamese Parallel Sentences	**Thầy giáo tháo giầy, tháo cả ủng,** **thủng cả áo**, đem **giáo án** mà **dán áo** **Nhà trường nhường trà, nhường cả hoa,** **nhòa cả hương**, lấy **lương hưu** để **lưu hương**		
English Meaning	Teachers take off their shoes, take off all their boots, have holes all over their shirts, use their lesson plan (paper) to paste on their shirts The school gives away the tea, gives away all the flowers, fades away the fragrance, uses retirement pension to retain the fragrance		
Vietnamese Word	thầy giáo	→	tháo giầy
English Meaning	teacher		take shoes off
Vietnamese Word	tháo cả ủng	→	thủng cả áo
English Meaning	take all boots		have holes all over shirts
Vietnamese Word	giáo án	→	dán áo
English Meaning	lesson plans		paste on shirts
Vietnamese Word	nhà trường	→	nhường trà
English Meaning	school		give away tea
Vietnamese Word	nhường cả hoa	→	nhoà cả hương
English Meaning	give away all the flowers		fade away the fragrance
Vietnamese Word	lương hưu	→	lưu hương
English Meaning	retirement pension		retain the fragrance

(c) A pair of parallel sentences

Figure 3: Spoonerism in Vietnamese oral form

2.3 Vietnamese Spoonerism Rules

There are several ways to make spoonerism in Vietnamese. Basically, spoonerism occurs when switching parts of one syllable to the other syllable to form Vietnamese words with different meaning. In particular, Vietnamese syllable is a combination of consonants, vowels, and tone. Thus, switching each of these components between two syllables are likely to make spoonerism. Spoonerism also occurs among there, four, or more consecutive syllables. Previous works presented several rules for making Vietnamese spoonerism but they are not sufficient and united. Therefore, in this paper, we synthesis Vietnamese spoonerism rules covered almost cases in practice and present extra rules covered some exceptional cases.

2.3.1 Spoonerism Rules for 2 Syllables

Rule #1: Switching Vowel and Final Consonant In this case, the vowel and final consonant are swapped together, leaving in place the initial consonant and tone. Figure 4 describes a transformation applying rule #1 between two syllables and an example.

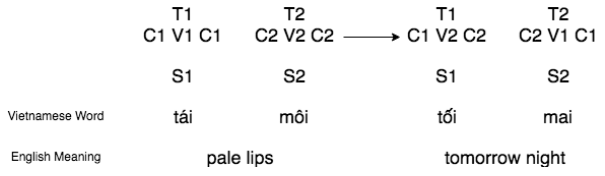


Figure 4: Rule #1 diagram and example. **C**, **V**, **T**, and **S** are **Consonant**, **Vowel**, **Tone**, and **Syllable** respectively.

Rule #2: Switching Initial Consonant In this case, the initial consonant is swapped, leaving in place the vowel, final consonant, and tone. Figure 5 described a transformation applying rule #2 between two syllables and an example.

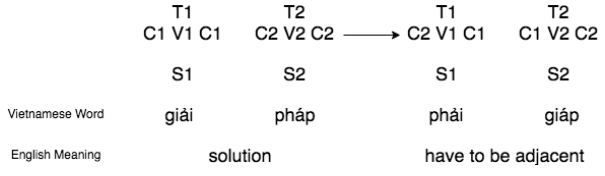


Figure 5: Rule #2 diagram and example

Rule #3: Switching Tone In this case, the tone is swapped, leaving in place the vowel and initial and final consonants. Figure 6 describes a transformation applying rule #3 between two syllables and an example.

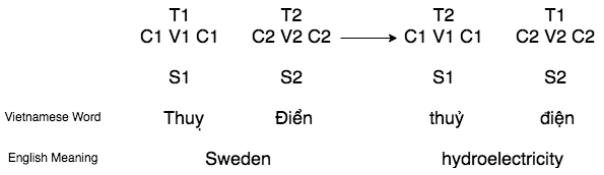


Figure 6: Rule #3 diagram and example

Rule #4: Switching Initial and Final Consonants and Vowel In this case, the initial and final consonants and vowel are swapped, leaving in place the tone. Figure 7 describes a transformation applying rule #4 between two syllables and an example.

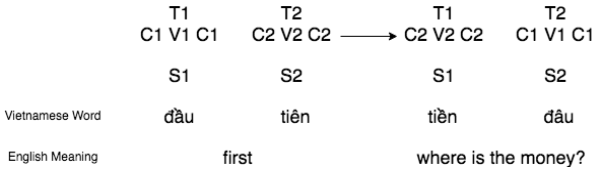


Figure 7: Rule #4 diagram and example

Rule #5: Switching Vowel, Final Consonant, and Tone In this case, the vowel, final consonant, and tone are swapped, leaving in place the initial consonant. Figure 8 describes a transformation applying rule #5 between two syllables and an example.

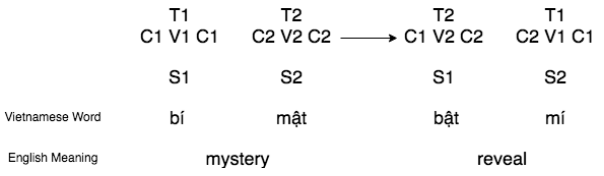


Figure 8: Rule #5 diagram and example

Rule #6: Switching Vowel In this case, the vowel is swapped, leaving in place the initial and final consonant and tone. Figure 9 describes a transformation applying rule #6 between two syllables and an example.

Rule #7: Switching Initial Consonant and Vowel In this case, the initial consonant and vowel are

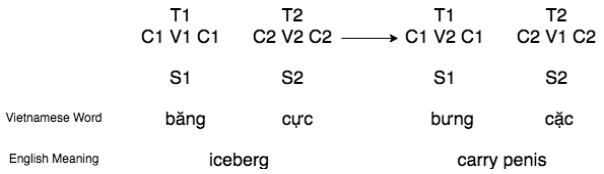


Figure 9: Rule #6 diagram and example

swapped, leaving in place the final consonant and tone. Figure 10 describes a transformation applying rule #7 between two syllables and an example.

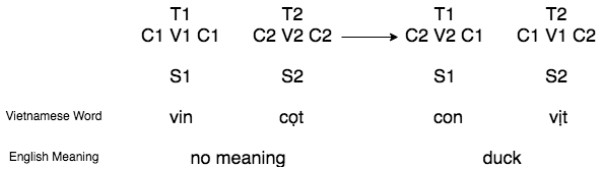


Figure 10: Rule #7 diagram and example

Rule #8: Switching Initial Consonant and Tone In this case, the initial consonant and tone are swapped, leaving in place the final consonant and vowel. Figure 11 describes a transformation applying rule #8 between two syllables and an example.

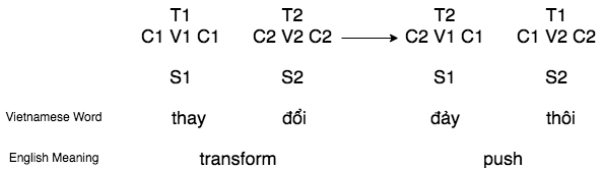


Figure 11: Rule #8 diagram and example

Rule #9: Switching two Syllables In this case, all components of the syllable are swapped. Figure 12 describes a transformation applying rule #9 between two syllables and an example.

2.3.2 Spoonerism Rules for more than two Syllables

In this section, we investigate spoonerism that occurs among more than two syllables. Spoonerism, in this case, can be seen as spoonerism between two syllables because only first and last syllables are swapped. Figure 13 presents spoonerism among three and four syllables.

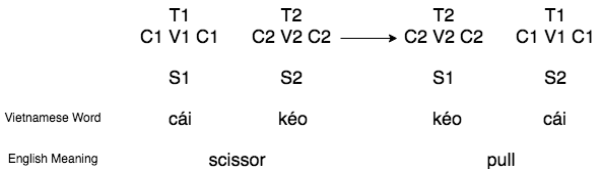
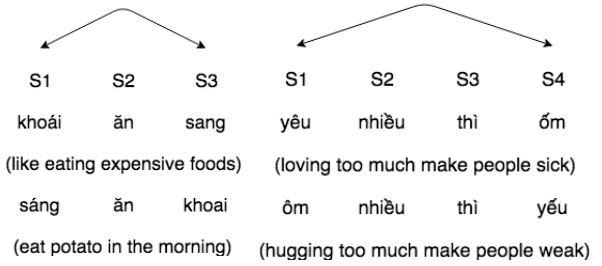


Figure 12: Rule #9 diagram and example



(a) 3-syllable (b) 4-syllable

Figure 13: Spoonerism among three and four syllables

2.3.3 Extra Rules for Exceptional Cases

Vietnamese spoonerism is based on phonology, not surface word, so some spoonerism cases may not follow rules in the previous section. Moreover, because of some restrictions when combining consonants with vowels in Vietnamese, in some cases, some consonants and vowels have to be replaced after switching parts of syllables. The most common extra rules are given below.

Extra Rule #1: *r*, *d*, *gi* Initial Consonants Interchangeability *r*, *d*, and *gi* have quite similar pronunciations so they can be interchanged after spoonerism to form meaningful words. Figure 14 shows an example of applying extra rule #1.

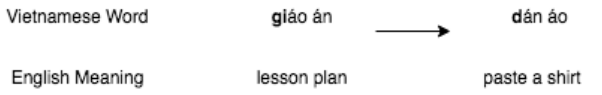


Figure 14: Extra Rule #1 example

Extra Rule #2: *x*, *s* Initial Consonants Interchangeability *x* and *s* have quite similar pronunciations so they can be interchanged after spoonerism to form meaningful words. Figure 15 shows an example of applying extra rule #2.

Extra Rule #3: *c*, *k*, *q* Initial Consonants Interchangeability Due to some rules of combining

Figure 15: Extra Rule #2 example

consonants and vowels in Vietnamese, although *c*, *k*, *q* have the same pronunciations, one vowel can only be combined with one of these consonants. Figure 16 shows an example of applying extra rule #3.

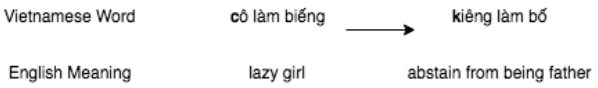


Figure 16: Extra Rule #3 example

Extra Rule #4: *tr*, *ch* Initial Consonants Interchangeability *tr* and *ch* have quite similar pronunciations so they can be interchanged after spoonerism to form meaningful words. Figure 17 shows an example of applying extra rule #4.

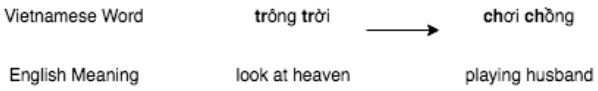


Figure 17: Extra Rule #4 example

Extra Rule #5: *n*, *ng* Final Consonants Interchangeability In some cases, final consonants *n* and *ng* can be in interchanged after spoonerism. Figure 18 shows an example of applying extra rule #5.

Extra Rule #6: *y*, *i* Vowels Interchangeability Due to some rules of combining consonants and vowels in Vietnamese, in some cases, writers use *y* instead of *i* and vice versa. Figure 19 shows an example of applying extra rule #6.

Extra Rule #7: *o*, *ô*, *ơ* Vowels Interchangeability In some cases, vowels *o*, *ô*, and *ơ* can be in interchanged after spoonerism. Figure 20 shows an example applying extra rule #7.

Extra Rule #8: *a*, *ă*, *â* Vowels Interchangeability In some cases, vowels *a*, *ă*, and *â* can be in interchanged after spoonerism. Figure 21 shows an example applying extra rule #8.

Figure 18: Extra Rule #5 example

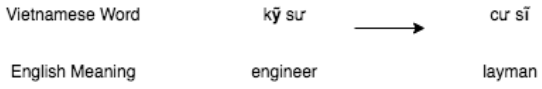


Figure 19: Extra Rule #6 example

3 Methodology

In this section, we present details of our system for Vietnamese spoonerism detection. Our system can detect both of two types of spoonerism: **Type 1** - when only the forward form of spoonerism appear in a sentence and **Type 2** - when both of forward and backward form of spoonerism appear in a sentence. Figure 22 shows examples of these two spoonerism types. In addition, our system handle spoonerism that occurs not only between two syllables but also among up to five syllables. The method used in our system is described in Algorithm 1 and details of each step in this algorithm are given below.

Syllable Pairs Generation From the input sentence, we generate syllable pairs as spoonerism candidate. Because our system handle spoonerism that occurs among up to five syllables, we select syllable pairs where the maximum distance between syllables in a pair is four syllables. One sentence with $(n > 4)$ syllables will have $4n - 10$ syllable pairs.

Syllable Decomposition To apply spoonerism rules for a pair of syllables, we need to break down each syllable to a set of initial and final consonants, vowels, and tones.

Reverse Form Generation After breaking down syllable pairs, we apply spoonerism rules and extra rules described in the previous section to generate reverse forms for each syllable pair. Because of some restrictions about combining consonants, vowels, and tones, after generating reverse forms, we remove reverse forms that violate these restrictions.

Type 2 Spoonerism Selection We compare each reverse form of each syllable pair with other syllable pairs. If they are matched, we select these syllable pairs as Type 2 spoonerism candidate.

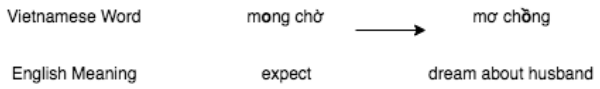


Figure 20: Extra Rule #7 example

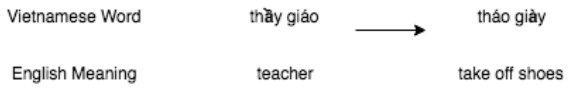


Figure 21: Extra Rule #8 example

Type 2 Spoonerism Conflict Resolution After detecting Type 2 spoonerism candidate set, some of these candidates might overlap together. Thus, we select candidates from this set so that they do not overlap together and they cover as many syllables as possible.

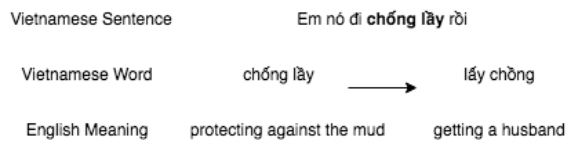
Language Model We collect 10.000 newspaper articles from the Internet to build Vietnamese language model. The language model used in our system is $n - gram$ language model with $n = 3$. We use KenLM toolkit (Heafield, 2011) to calculate this language model.

Vulgar Word Dictionary Vietnamese people often use spoonerism to describe things in vulgar way while our language model is built from formal texts. Thus, we create a dictionary which consists Vietnamese vulgar word from Internet to improve the performance of our language model.

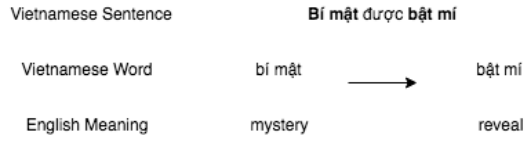
Type 1 Spoonerism Selection After select Type 2 spoonerism pairs, we take other syllable pairs that do not overlap with Type 2 spoonerisms pairs as Type 1 spoonerism candidates. We calculate the score for each reverse form (except rules $\#3, \#5, \#8, \#9$) of each Type 1 candidate. If there are reverse forms that contain words in dictionary, we choose the one that has the highest score from these reverse forms. If not, we choose the reverse form that has the highest score. The score for each syllable pair is calculate by KenLM toolkit (Heafield, 2011). For example, we have the input sentence $S = s_1 s_2 ... s_n$ where s_i is the i^{th} syllable in this sentence. The score for syllable pairs (s_j, s_{j+k}) is computed as

$$score = \log_{10} p(s_j, s_{j+1}, ..., s_{j+k})$$

We then choose the candidates which have their reverse form's scores greater than the threshold as Type 1 spoonerisms.



(a) Type 1



(b) Type 2

Figure 22: Two spoonerism types

Type 1 Spoonerism Conflict Resolution After detecting Type 1 spoonerism candidate set, some of these candidates might overlap together. To solve this problem, we use greedy algorithm strategy. First, we choose the candidate with the highest score and then choose the next candidate with the highest score that does not overlap with this candidate. We continue to do so until we cannot choose candidate anymore. The candidates that we have chosen are Type 1 spoonerisms.

4 Results and Discussions

4.1 Data

We conduct experiments on the Vietnamese Spoonerism dataset collected from Vietnamese documents including poems, folk tales and songs, parallel sentences, and other oral speech forms. After normalization, this dataset includes 300 Vietnamese spoonerism sentences. In some cases, both of forward and backward form of spoonerism can appear in a sentence (**Type 2**), while in other cases only the forward form can appear in a sentence (**Type 1**). We take 150 sentences from this dataset as a development set and take the rest as a testing set. Table 4 presents the numbers of **Type 1** and **Type 2** spoonerisms in development and testing sets. Numbers in parentheses present the quantity of spoonerisms covered by spoonerism and extra rules described in the previous section.

4.2 Evaluation Method

We evaluate the performance of our system for detecting each type of spoonerism with $F_1 = \frac{2*\mathrm{P}*\mathrm{R}}{\mathrm{P}+\mathrm{R}}$.

		2-syllable	3-syllable	4-syllable	5-syllable
Dev	Type 1	13 (11)	6 (6)	1 (1)	0 (0)
	Type 2	110 (91)	15 (13)	7 (6)	0 (0)
Test	Type 1	13 (12)	4 (4)	1 (1)	0 (0)
	Type 2	110 (101)	18 (15)	8 (8)	1 (1)

Table 4: Statistics of spoonerism types in development and testing sets

Precision (P) and recall (R) are the percentage of correct spoonerism identified by the system and the percentage of identified spoonerism present in the corpus respectively.

4.3 Results

In this section, we analyze the performance of our system for detecting Vietnamese spoonerisms including Type 1 and Type 2.

Type 2 Spoonerism Evaluation In the first experiment, we evaluate the capacity of our system for detecting Type 2 spoonerism on the development and testing sets. Because some spoonerisms are not covered by rules implemented in our system, we examine in both cases with and without these spoonerisms. Table 5 shows the performance of our system on Vietnamese spoonerism dataset. Numbers in parentheses present the performance of our system when excluding out-of-rule spoonerisms.

	Precision	Recall	F1-score
Dev	100.00 (100.00)	86.36 (100.00)	92.68 (100.00)
Test	99.21 (99.21)	91.30 (100.00)	95.09 (99.60)

Table 5: Performance of our system for Type 2 spoonerism detection on Vietnamese spoonerism dataset

As seen in this table, our system is certain to detect all Type 2 spoonerisms covered by rules described in section 2.3.

Type 1 Threshold Selection As discussed in section 3, we use language model to calculate the score of each Type 1 spoonerism candidate and then choose candidates whose scores are greater than the threshold. Thus, we use the development set to find the optimized thresholds. In particular, we calculate a score for each Type 1 candidate in the development set and find the thresholds that maximize the F_1 score of detecting Type 1 spoonerism on this set. We find each threshold for each 2, 3, and 4-syllable Type 1 spoonerism. The best optimized thresholds found on the development set are **-5.9** for 2-syllable spoonerism, **-8.4** for 3-syllable spoonerism, and **-12.1** for 4-syllable spoonerism.

Type 1 Spoonerism Evaluation In the third experiment, we evaluate the performance of our system for detecting Type 1 spoonerism on the development and testing sets. After recognizing Type 2 spoonerisms, we extract Type 1 spoonerism candidates and use dictionary and language model to determind whethere or not these candidates are actual Type 1 spoonerisms. Table 6 and tableřeftab:8 show the performances of our system for detecting Type 1 spoonerism and both of Type 1 and Type 2 spoonerisms respectively on Vietnamese spoonerism dataset. Numbers in parentheses present the performance of our system when excluding out-of-rule spoonerisms.

	Precision	Recall	F1-score
Dev	55.56 (55.56)	55.56 (61.11)	55.56 (57.89)
Test	66.67 (66.67)	63.16 (66.67)	64.87 (66.67)

Table 6: Performance of our system for Type 1 spoonerism detection on Vietnamese spoonerism dataset

	Precision	Recall	F1-score
Dev	93.28 (93.08)	82.24 (94.53)	87.41 (93.80)
Test	95.17 (95.14)	87.90 (95.80)	91.39 (95.47)

Table 7: Performance of our system for Type 1 and Type 2 spoonerisms detection on Vietnamese spoonerism dataset

As seen in these tables, the F_1 scores for detecting Type 1 spoonerism and both of Type 1 and Type 2 spoonerisms are 66.67% and 95.47% respectively on the testing set.

5 Conclusion

In this work, we have presented the first spoonerism detection system for the Vietnamese language, which achieves an F_1 score of 95.47% on the Vietnamese spoonerism dataset. We have also shown the effectiveness of using Vietnamese language model and dictionary for detecting spoonerism in Vietnamese sentences.

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