Pivot-Based Hybrid Machine Translation to Support Multilingual Communication

by Nasution Arbi Haza

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Abstract—Machine Translation (MT) is very useful in supporting multicultural communication. Existing Statistical Machine Translation (SMT) which requires high quality and quantity of corpora and Rule-Based Machine Translation (RBMT) which requires bilingual dictionaries, morphological, syntax, and semantic analyzer are scarce for low-resource languages. Due to the lack of language resources, it is difficult to create MT from high-resource languages to low-resource languages like Indonesian ethnic languages. Nevertheless, Indonesian ethnic languages' characteristics motivate us to introduce a Pivot-Based Hybrid Machine Translation (PHMT) by combining SMT and RBMT with Indonesian as a pivot which we further utilize in a multilingual communication support system. We evaluate PHMT translation quality with fluency and adequacy as metrics and then evaluate usability of the system. Despite the medium average translation quality (3.05 fluency score and 3.06 adequacy score), the 3.71 average mean scores of the usability evaluation indicates that the system is useful to support multilingual collaboration.

1. Introduction

Machine Translation (MT) is very useful in supporting multicultural communication, but scarce for low-resource languages. Existing MT researches are Statistical Machine Translation (SMT) which requires high quality and quantity of corpora and Rule-based Machine Translation (RBMT) which requires bilingual dictionaries, morphological analyzer, syntax analyzer (parser) and semantic analyzer. There are research challenges when we want to create MT from high-resource languages (HRL) to low-resource languages (LRL) like Indonesian ethnic languages which are the scarcity of corpora, sizable dictionary, good morphological, syntax and semantic analyzer. Nevertheless, Indonesian ethnic languages characteristics, i.e., several clusters of similar languages with morphology and syntax similarity, motivate us to find an answer to these challenges. We address the following research goals:

- *Developing a pivot-based hybrid machine translation (PHMT)*: We combine SMT and RBMT to bridge the gap between HRL and LRL.
- *Supporting multilingual communication with the PHMT*: We implement the PHMT to develop a multilingual communication support system.

The rest of this paper is organized as follows: In Section 2, we will briefly discuss our proposed PHMT. Section 3 discusses our experiments and the results. Finally, Section 4 concludes this paper.

2. Pivot-Based Hybrid Machine Translation

Recently, [1] introduced the promising approach of creating bilingual dictionary A-C with only bilingual dictionaries A-B and B-C as input. The output machine readable bilingual dictionary is wrapped as a service in Language Grid [2] to support intercultural collaboration [3]. We combine Google Translate service and Bilingual Dictionary service as a composite service in Language Grid as shown in Figure 1. In this paper, we create English-Minangkabau PHMT with Indonesian as pivot, since Minangkabau has 61.59% lexical similarity with Indonesian based on ASJP [4], thus the morphology and syntax is also similar. Therefore, we expect that Indonesian-Minangkabau word-to-word translation is acceptable.

Figure 1. PHMT as a Language Grid Composite Service.

3. Experiment

To provide multi-language support system for international symposiums, [5] combined human inputters and language services. The PHMT is used to support multilingual communication with similar settings. In this experiment, the system support Minangkabau speaker audience to understand English presentation. Indonesian-Minangkabau Dictionary Service has 5,391 entries.

3.1. Experiment Settings

A video of English presentation was played to 165 bachelor of Informatics Students, Islamic University of Riau, Indonesia. The video and the system were displayed in a separate screen. While listening to the English presentation, one inputter input summarized and simplified English sentences to the system. Audiences could also view the system from any web browser (via personal PC or smartphone) as shown in Figure 2.

TABLE 1. USABILITY EVALUATION OF PHMT

Question	Rate of Each Scale*					mean
	1	2	3	4	5	
Was the interface easy to look at?	0.006	0.073	0.341	0.246	0.335	3.81
Did you understand the content of the presentation?	0.000	0.056	0.335	0.385	0.223	3.74
Was the Minangkabau translation result correct?	0.000	0.207	0.458	0.257	0.078	3.25
Was the Minangkabau translation result easy to understand?	0.000	0.089	0.464	0.307	0.140	3.51
Was the Minangkabau translation result helpful to understand the presentation?	0.006	0.078	0.458	0.291	0.168	3.56
Was the translation displayed in a timely manner?	0.006	0.045	0.296	0.346	0.307	3.96
Do you think this system is needed and important to support multilingual communication in international seminar between English native speaker with non-native audience?	0.006	0.022	0.251	0.257	0.464	4.11

* Scaled from 1 (Extremely Disagree) to 5 (Extremely Agree)

Figure 2. PHMT to Support Multilingual Communication.

3.2. Experiment Result

We assessed the translation quality of both English-Indonesian translations and Indonesian-Minangkabau translations and further evaluated the usability of the multilingual communication support system.

3.2.1. Translation Quality Assessment. We assessed the translation quality with fluency and adequacy as measures following the linguistic data annotation specification [6] with small modification on the 5-point scale (from scale 1 for the lowest score to 5 for the highest score). Fluency refers to the degree to which the translation is well formed according to the rules/grammars of the language. A fluent translation is one that is well-formed grammatically, has correct spellings, using common terms, titles and names, is intuitively acceptable and can be sensibly interpreted by a native speaker of the language. The fluency and adequacy of the English-Indonesian translations and Indonesian-Minangkabau translations are evaluated by bilingual speakers of those languages as judges. The average fluency score of English-Indonesian translations and Indonesian-Minangkabau translations are 3.52 and 3.05 respectively. Adequacy refers to the degree to which information existed in the original sentences is also conveyed in the translations. The judges determine whether the translation is adequate by comparing the English-Indonesian translations and Indonesian-Minangkabau translations against the reference translations. The average adequacy score of English-Indonesian translations and Indonesian-Minangkabau translations are 3.59 and 3.06 respectively.

3.2.2. Usability Evaluation. The multilingual support system with Pivot-based Hybrid Machine Translation which has 3.71 average mean scores as shown in Table 1 is useful to support multilingual collaboration.

4. Conclusion

There are only small decreases of translation quality of the Indonesian-Minangkabau translations from the English-Indonesian translations which are 13% for the average fluency score and 15% for the average adequacy score. Even though the fluency and adequacy scores are considered medium, but the result is promising since we only applied the simplest RBMT method, i.e, word-to-word translation of English-Indonesian translations to Minangkabau.

Based on the audience's comments from the questionnaire, in our future work, we will improve the PHMT quality by refining and adding more entries to the Indonesian-Minangkabau bilingual dictionary by consulting language experts. We will also utilize multiple inputter to improve translation speed and quality in supporting multilingual communication.

Acknowledgments

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