The Designing and Construction of Domain-oriented Vietnamese-English-Chinese FrameNet

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Abstract. Frame Semantics and the FrameNet are known as an example of a semantic theory model supporting large engineering projects of knowledge representation and maintaining a long-term vitality. At the same time, the initial goal of FrameNet is to build a large online computational dictionary, so the semantic frames are lacking in systematicness and hierarchy from the whole, and did not distinguish between the two concepts "semantic domain" and "topic domain". These problems make it difficult to unify the concrete goal, the domains, the frame structure, the annotation method and the overall scale of the non-English FrameNet construction and have created some obstacles for multilanguage FrameNets to the applications of NLP. As a result, we propose some ideas on Domain-oriented Multilingual Frame Semantic Representation(DOMLFSR). The construction of Domain-oriented Vietnamese-English-Chinese FrameNet(DOV-E-CFN) is a concrete practice of DOMLFSR. On the basis of DOV-E-CFN, we gave a preliminary analysis of event extrction application based on kernel dependency graph(KDG).

Keywords: domain-oriented, frame semantics, Vietnamese, knowledge representation, event extraction

1 Introduction

Frame Semantics and the FrameNet are known as an example of a semantic theory model supporting large engineering projects of knowledge representation and maintaining a long-term vitality[1]. Frame semantics has a complete system, is an effective knowledge representation with empirical semantic properties against the background of cognitive mechanism, and directly oriented to the application. FrameNet is characterized as an organic unification of theoretical guidance and empirical induction, with outstanding multi-language expandability and domain extensibility[2].

The initial goal of FrameNet is to build a large online computational dictionary, so the semantic frames are lacking in systematicness and hierarchy from the whole[3]. In recent years, FrameNet began to pay attention to the understanding of domain corpus text[4], but still did not distinguish between the two concepts "semantic domain" and "topic domain". Although the construction of non-English FrameNets has developed rapidly[5-7], they also have the similar problems. These problems make it difficult to

adfa, p. 1, 2011.

unify the concrete goal, the domains, the frame structure, the annotation method and the overall scale of the non-English FrameNet construction and have created some obstacles for multi-language FrameNets to the applications of NLP. As a result, we propose some ideas on Domain-oriented Multilingual Frame Semantic Representation (DOMFSR).

Vietnamese is an Austroasiatic language and has many similarities with Chinese. On the other hand, Vietnamese is spoken by about 82 million people, the Internet development enabled Vietnam to rank among the countries which enjoy the fastest growth in the number of Internet users in the world. This provides a great convenience for us to build a Domain-oriented Vietnamese-English-Chinese FrameNet (DOV-E-CFN). The construction of DOV-E-CFN is a concrete practice of DOMLFSR.

We chose "vietnamnet.vn" and "xaluan.com" as the Vietnam News corpus source. Currently, the news texts categories with reference to "http://vietnamnet.vn/vn/chinh-tri/" and divided into five topics: Foreign News (Đối Ngoại), Congress News (Thời Sự Quốc Hội), Constitutional amendments News (Sửa Hiến Pháp), Anti-Corruption News (Chống Tham Nhũng), Salary reform News (Cải Cách Lương). We focuses on Foreign News (Đối Ngoại) in this paper. Correspondingly, the main corpus source in English and Chinese includes the following websites: "ifeng.com", "huanqiu.com", "bbc.co.uk", "inquirer.net". The size of corpus has been obtained is more than 5000 texts, about 30M.

The rest of the paper is structured as follows. Section 2 provides a brief overview of the DOMFSR designing, including the overall architecture, the Frame element hierarchical system and the Frame semantic construction expression system; Section 3 describes the specific process of DOV-E-CFN construction, including designing and developing news corpus extraction software to build domain corpus of Vietnamese, English and Chinese; exploring the building methods of lexical unit(LU) database and semi-automatic mapping method of frame database; designing and implementing assistive tools to build DOV-E-CFN, especially to annotate example sentences; Section 4 gives a preliminary analysis of event extrction application based on kernel dependency graph. Finally, sections 5 concludes and provides an outlook on future research.

2 The DOMFSR designing

2.1 DOMLFSR overall architecture

After the comparative analysis of the construction methods and characteristics of the main non-English FrameNets, we present DOMLFSR mode as a theoretical model of domain-oriented multilingual FrameNet construction.

Because there is a relative lack of previous studies in Vietnamese[8], in order to make the research more targeted, in the process of frame element hierarchical system(FEHS) and frame semantic construction expression system(FSCES) construction, we put more attention on the analysis and consolidation of related Vietnamese lan-

guage phenomena, summarizing the characteristics of the type of language to facilitate a future expansion to other similar language.

Specifically, we set up a relatively fixed three-tier hierarchical frame element system of 35 frame elements, and the frame elements of fourth-tier are expandable according to the specific needs identified in the domain-oriented multilingual FrameNet construction.

DOMLFSR overall architecture is shown in the following Figure 1.

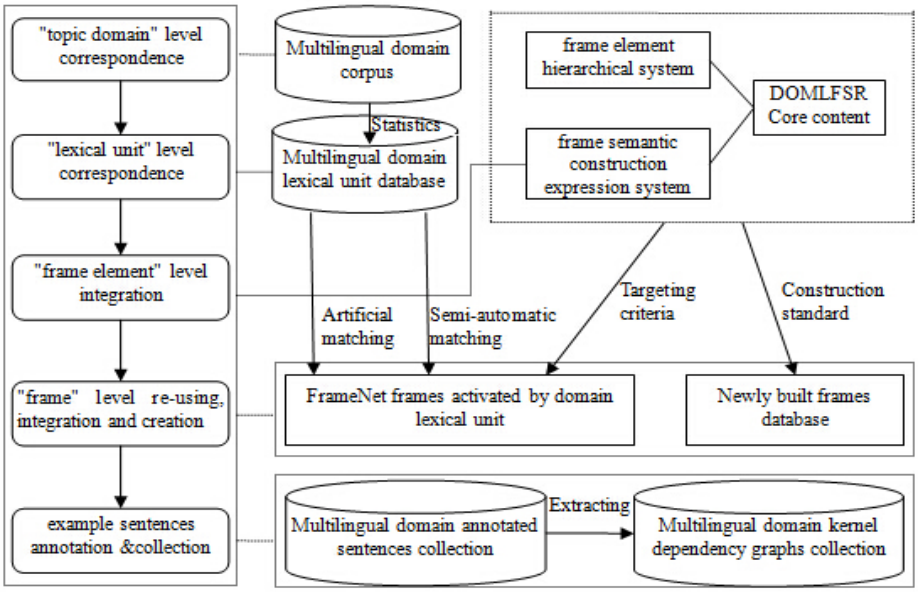

Fig. 1. DOMLFSR overall architecture

2.2 Frame element hierarchical system

Multilingual integration is more important than multi-language expandation in DOMLFSR, that is to say, cross-linguistic "multilinguality" will be realized in a same frame. we will build a relatively unified "frame element hierarchical system", making a primary reference for name, definition and annotation color of frame element, some adjustment will be made according to actual demand.

Table 1. The Core Frame Element of DOMLFSR

Tier 1	Tier 2	Tier 3				
		Chinese	English	Vietamese	Vietamese frame element kasus (FK)	HEX code

Core Frame Element	Subjects	施事	agent, Agt	vai tác thể	bị, được, do, bởi	FF0000
		当事	essive, Ess	vai thực thể	bị, được	FFFF00
		感事	expierencer, Exp	vai nghiệm thể	bị, được, vì	DC143C
		致事	causer, Cau	vai gây sự	bị, được	008080
		领事	possessor, Pos	vai chủ sở hữu	của	FF00FF
	Objects	受事	patient, Pat	vai bị thể	vào	00008B
		客事	entity, Ent	vai đối tượng	đối với, đến, ở, vào, cho	FF1493
		役事	causee, Cae	vai bị bắt buộc		6495ED
		成事	product, Prod	vai sản vật	thành, ra	00FF7F
	Relevances	与事	dative, Dat	vai tiếp thể	cho	FFE4C4
		协事	companion, Comp	vai đối chiếu	với, cùng, bằng	00FF7F
		类事	classification, Clas	vai tương ứng	như, trừ, làm, trở thành, trở nên	FF7F50
		属事	belongings, Belo	vài thuộc thể	của	7FFFAA
		位事	destination, Dest	vai đích thể	ở	F5DEB3

FEHS has the following characteristics: the hierarchical system is corresponding to the verbal semantic classification; the system includes a hierarchical set of markup symbols, frame element HEX color code and the corresponding background color. In addition, it ensures that the same color will not use repeatly in the same FrameNet, while ensuring the a frame elements consistent with the same background color in different FrameNet[9]. It is of great importance to frame construction, sentence annotation and the valence patterns statistics of lexical unit, providing precondition for DOMLFSR.

2.3 Frame semantic construction expression system

To meet the needs of positioning domain frame hierarchical relationship accurately, we will build “frame semantic construction expression system”(FSCES) as a relatively complete hierarchical system of “semantic domain”[10], then mapping with Chinese Thesaurus -Tongyici Cilin (Extended Edition).

Table 2. Chinese and Vietanamese FSCES (Excerpts)

Semantic Classification				Frame Semantic Construction Expression System (FSCES)			
Tier 1	Tier 2	Semantic Features	Valency	Chinese basic FSCES		Vietnamese basic FSCES	
Action/ Behav-ior	Independent action	[Action] [Control]	Monova-lent	ca	施事+Vp	va	Np_Agt+Vp
				cb	Vp+施事	vb	Vp +Np_Agt
				cc	领事+Vp+施事		
	Dominate	[Action] [Control] [Transi-tive]	Divalent	ca	施事+Vp+受事	va	Np_Agt +Vp+Np_Pat
				cb	施事+把/将+受事+Vp	vb	Np_Pat +bị+(Np_Agt)+Vp
				cc	受+被/由/归+(施事)+Vp	vc	Np_Pat + bị+Vp +do+Np_Agt
	Manufacture	[Action] [Control] [result]	Divalent	ca	施事+Vp+成事	va	Np_Agt +Vp+Np_Prod
				cb	施事+把+成事+Vp	vb	Np_Prod +bị +Np_Agt +Vp
				cc	成事+被+施事+Vp	vc	Np_Prod +(Np_Agt)+Vp
				cd	成事+(施事)+Vp		
	Displacement	[Action] [Control] [Direc-tion]	Divalent	ca	施事+Vp+(介词)+位事	va	Np_Agt+Vp+K+Np_Dest
				cb	施事+位事+Vp	vb	Np_Agt+Np_Dest+Vp
				cc	位事+Vp+施事	vc	Np_Dest+Vp+Np_Agt
	Placement	[Action] [Control] [Exist-ence]	Trivalent	ca	施事+位事+Vp+受事	va	Np_Agt +Vp+ Np_Pat + Np_Dest
				cb	施事+Vp+受事+位事	vb	Np_Pat + (được/bị)Np_Agt +Vp+ Np_Dest
				cc	施事+(把)受事+Vp+位事	vc	Np_Dest + Np_Agt +Vp+ Np_Pat
				cd	受事+(被)施事+Vp+位事	vd	Np_Agt +Vp+ Np_Dest + Np_Pat
				ce	位事+施事+Vp+受事	ve	Np_Dest +Vp+ Np_Pat
				cf	施事+Vp+位事+受事		
				cg	位事+Vp+受事(施事隐含)		

The “frame semantic construction expression system” is a hierarchical system of theoretical deduction on the collocation pattern between target lexical unit and core

frame element. As the main emphasis of DOMLFSR, it can provide a basis for the analysis and annotation of sentential semantic structure.

We argues that based on the study of native language researchers, it should build a "frame semantic construction expression system" as a theoretical hierarchical system for deducting the collocation between target lexical unit and core frame element, providing the basis for semantic structure analysis and annotation of example sentences. At this stage, Chinese and Vietanamese FSCES is the focus of the study, English lexical unit semantic description of Berkeley FrameNet will be integrated in the next step.

3 The DOV-E-CFN construction

The DOV-E-CFN is driven by NLP tasks, and has implemented an organic collocation and combination of three languages in the same semantic frame.

A concrete integration realized in three levels:

- The DOV-E-CFN corpus preparation: corre-sponding in the "topic domain" level;
- Domain lexical unit Collection and classification: integration in the "semantic domain" level;
- Frame System and its relationship description: reusing, integration and newly built.

Corpus preparation has been introduced earlier in Introduction. The following descriptions are about the second and third points.

3.1 Domain lexical unit collection and classification

After the word segmentation, POS tagging and word frequency statistics, we obtained the following data:

- There are 445 high-frequency words in English news corpus (1783 articles), which frequency of occurrence is more than 200 times, including 60 verbs, accounting for a lower proportion of 13.48%.
- There are 1064 high-frequency words in Chinese news corpus (2296 articles), which frequency of occurrence is more than 200 times, including 229 verbs, accounting for a proportion of 21.52%.
- There are 1433 high-frequency words in Vietnamese news corpus (2500 articles), which frequency of occurrence is more than 200 times, including 344 verbs, accounting for a proportion of 24.01%.

Table 3. Semantic classification of high frequency verbs of DOV-E-CFN (Excerpts)

Vietnamese LU	*English LU*	*Chinese LU*	*Chinese LU Valency*	*Tongyici Cilin classification code*
đề cập	mention	提及	Trivalent	Hi12A51#

kể	tell, relate	讲述	Trivalent	Hi13D01
lên tiếng	claim	声明	Trivalent	Hi13D08
báo cáo	report	报告	Trivalent	Hi15A01
đối phó	deal	应对	Divalent	Hi18B01
chấp nhận	accept, admit	承认	Trivalent	Hi22A01
can thiệp	intervene, interfere	干涉	Divalent	Hi23A01
bàn giao	transfer	移交	Trivalent	Hi27A08@
đối thoại	dialogue	对话	Divalent	Hi31A01
thỏa thuận	consent	协商，商定	Trivalent	Hi31A01

The synonymous Vietnamese-English-Chinese lexical units will be put into the same semantic frame to to retrieve the example sentences from respective news corpus.

3.2 Frame system and the frame-frame relationship description

The corresponding frames in Berkeley FrameNet can be evoked by domain English lexical units in Table 3. We reuse and integrate applicative frames of FrameNet primarily. After semi-automatic mapping, we chose 22 frames as an initial frame system of DOV-E-CFN.

Table 4. The initial frame system of DOV-E-CFN

No.	***English frame name***	***Chinese frame name***	***Vietnamese frame name***
1.	(Statement)	声明	Tuyên bố
2.	(Cause_change_of_position_on_a_scale)	造成位置变化	Gây ra thay đổi vị trí
3.	(Intentionally_create)	有意识创造	Cố ý tạo nên
4.	(Taking_sides)	偏袒	Đứng về phe
5.	(Giving)	给	Cho
6.	(Perception_experience)	认知体验	Kinh nghiệm nhận thức
7.	(Cause_to_perceive)	引起感知	Gây ra cảm nhận
8.	(Supply)	供应	Cung cấp
9.	(Impact)	影响	Tác động

10.	(Posture)	姿态	Tư thế
11.	(Grant_permission)	授予权限	Cấp phép
12.	(Awareness)	意识	Nhận thức
13.	(Possession)	拥有	Sở hữu
14.	(Compliance)	遵从	Tuân thủ
15.	(Request)	要求	Yêu cầu
16.	(Change_posture)	变化姿势	Thay đổi tư thế
17.	(Becoming_aware)	知悉	Trở thành nhận thức
18.	(Manufacturing)	制造	Chế tạo
19.	(Compatibility)	相容	Khả năng tương thích
20.	(Cause_motion)	引起运动	Gây ra chuyển động
21.	(Placing)	放置	Đặt
22.	(Bringing)	带来	Đưa

According to the FEHS, some frame elements in original frames of Berkeley FrameNet have been adjusted to meet the new requirements of DOV-E-CFN. Figure 2 shows the adjustment to core frame element of frame "Bringing".

Fig. 2. The adjustment to core frame element of frame "Bringing"

In fact, there is no absolute boundaries between adjusting, integrating existing frames and builting new frames. According to investigation and the situation of other objective factors, we found that 18 domain lexical units have no corresponding frame in Berkeley FrameNet and need to newly built. The source and proportion of DOV-E-CFN frames shows in Figure 3.

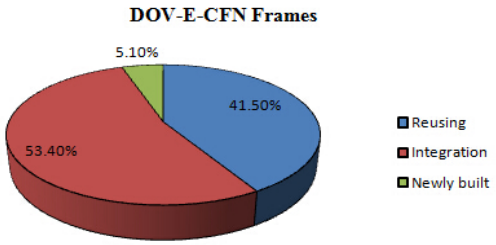

Fig. 3. The source and proportion of DOV-E-CFN frames

Because of smaller number, it is difficult to describe the frame-frame relations in a domain FrameNet according to the Berkeley FrameNet model. We proposed that in the frame system of domain-oriented multilingual FrameNet, the positioning of reused and newly built frames depends on the semantic classification of FSCES and Chinese Thesaurus -Tongyici Cilin (Extended Edition).

3.3 Example sentence annotation

Lexical unit and sentence annotation database construction are based on data statistics from Vietnamese-English-Chinese domain Foreign News corpus. The annotation format of example sentence is:

{<FE-PT-GF-(other)-(NE)□w>}$_0^n$<tgt- PT-GF□w>{<FE-PT-GF-(other)-(NE)□w>}$_0^n$

The target lexical unit is identified as "tgt"; "w" is to identify the specific text content; other symbols as "FE", "PT", "GF", "NE" are referring to frame element, phrase type, grammatical function and named entity. The tagset we used in annotating divided into two kinds of English and Chinese. The specific annotating results are shown as follows.

Example sentence (1):

(1) chúng tôi/P sẽ/R giải quyết/V các/L thách thức/N trong/E tương lai/N.

(We will resolve the challenges of the future.)

Annotating results in English tagset:

<Agt-NP-sub chúng tôi/P><ADP-adva sẽ/R><tgt-VP-pre giải quyết><Prob-NP-obj các/L thách thức/N><Time-PP-adva trong/E tương lai/N>

Annotating results in Chinese tagset:

<施事-名词短语-主语 chúng tôi/P><副词短语-状语 sẽ/R><词元-动词短语-谓语中心语 giải quyết><问题-名词短语-宾语 các/L thách thức/N><时间-介词短语-状语 trong/E tương lai/N>

In specific annotation aspect, the characteristics of Vietnamese phrase type and the grammatical functions is deserving more attention in order to make up for the inadequacy of Vietnamese vocabulary semantic resources to some extent. All the Vietnamese-English-Chinese annotated sentences constituted a frame semantic annotation database.

4 Application exploration

Event extraction, an important research direction in the field of information extraction, has broad application prospects in automatic summarization, automatic question answering and information retrieval etc. Mapping the structure and meaning of language has been considered as one of the basic principles of reearches in Computational Linguistics and Language Information Processing, starting from the bottom of the language law, the pattern-matching event extraction method has important significance for domain-oriented multi-language news events extraction. So, the application of frame semantic annotation in event extraction is another major research topic of the paper.

Kernel dependency graph(KDG) includes small packages of information that associate the lexical head (governor) of a set of related dependents, the lexical heads of the constituents that are dependent on that governor, and the frame-specific semantic relations by which the dependent elements are related to the governor[11].KDGs derived from a large corpus will provide a database offering reliable information about frequencies and collocations in the kind of corpus being used, and KDGs recognized in specific documents can be read off as indications of the subject matter and basic claims of given passages in the documents[12].

We built a DOV-E-CFN to explore the specific application of this method based on the kernel dependency graph(KDG). The method is based on semantic structure extraction, the main contents include KDG semantic analysis model; KGD automatic generation and event templates extraction based on KDG. It can be represented more intuitive by KDG when there is conflict between semantic and syntactic structure expression, such as support verb, transparent nouns, null instantiation and frame element fusion etc.

The KDG of example sentence (2) shows the analysis process of null instantiation.

(2) Sát thủ săn ngầm P-8A Poseidon của Hải quân Mỹ, dự kiến sẽ thay thế cho máy bay P-3C.

(Submarine P-8A Poseidon of US Navy which is called Hunter killer, is expected to replace the P-3C aircraft.)

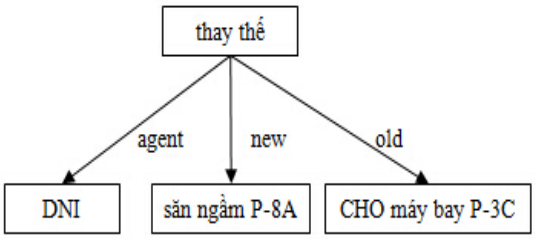

Fig. 4. Null Instantiated FEs of Vietnamese sentence

By analyzing the main process of FrameNet semantic analysis and the event extraction, we have made a feasibility demonstration that frame semantic annotation can

be applied in event extraction and proposed a conversion method to generate kernel dependency graphs (KDG) and event template from annotated sentences.

In order to extract event informations not only on the whole but also on parts, we tried to design and use the specific methods based on KDG to extract event informations of the Foreign News in Vietnamese, English and Chinese, especially in complex long sentences of news texts.

Example sentence (3) is comprising a plurality of target lexical untis. Its KDG generation and event model extraction process is as follows.

(3) Để phục vụ mục tiêu này, Chính phủ Mỹ cần sớm bỏ hoàn toàn lệnh cấm bán vũ khí cho Việt Nam và đóng góp tích cực hơn nữa trong việc giải quyết hậu quả chiến tranh.

(To achieve this goal, the US government must abandon completely the ban on arms sales to Vietnam as soon as possible, and make more positive contribution in solving the the legacy of war.)

Step 1, identify the target lexical units in sen-tence, determine the semantic frames they belongs to.

Step 2, determine annotation range. (3)' shows all the currently-annotated target lexical units in uppercase: PHỤC VỤ(achieve), BỎ(abandon), BÁN(sale), LỆNH CẤM(ban), ĐÓNG GÓP(contribute), GIẢI QUYẾT(solve); and followed by the names of their frames in boldface. This includes a number of nouns such as LỆNH CẤM in the Prohibiting frame whose frames are relatively simple, and so will not be discussed further.

(3)' Để PHỤC VỤ Function mục tiêu này, Chính phủ Mỹ cần sớm BỎ Activity_stop hoàn toàn LỆNH CẤM Deny_permission BÁN Commerce_sell vũ khí cho Việt Nam và ĐÓNG GÓP Giving tích cực hơn nữa trong việc GIẢI QUYẾT Resolve_problem hậu quả chiến tranh.

Because the current annotation range is the target lexical units in main clause, so we do not pay attention to PHỤC VỤ(achieve) in the adverbial.

Step 3, generate the corresponding KDG. Theoretically, all of the information shown in this graph was extracted algorithmically from the XML format of the FrameNet annotations[13]. But at the present stage, only simple sentence which contains only one target lexical unit can be extracted automatically based on the annotated format. The KDG of example sentence (3) shows in Figure 5 is manually generated.

In Figure 6, target lexical units are represented as nodes with their FEs as their dependents; the text of the node itself is <Frame name>,<LU name>.<POS>. The arrows to the dependents are labeled with the FE name. Named entity are highlighted in rose red.

Step 4, According to the KDG, we can Get extraction rules as an event template.

Event template of example sentence (3):

1. { Type=目的: < Purpose >； Type=施事: < Agent >； Type=当事: < Theme > }< Purpose >< Agent >< tgt= bỏ >< Theme >;
2. { Type=目的: < Purpose >； Type=施事: < Agent >； Type=当事: < Theme > }< Purpose >< Agent >< tgt= đóng góp >< Theme >;

3. { Type=权威方: < Authority >；Type=行为: < Action >；(Type=当事方: < Protagonist >)}< Authority >< tgt= lệnh cấm >< Action >(< Protagonist >);
4. { (Type=卖方: < Seller >)；Type=商品: < Goods >；Type=买方: < Buyer > }(< Seller >) < tgt= bán >< Goods > cho < Buyer >;
5. { Type=施事: < Agent >； Type=问题: < Problem > }< Agent ><tgt= giải quyết >< Problem >.

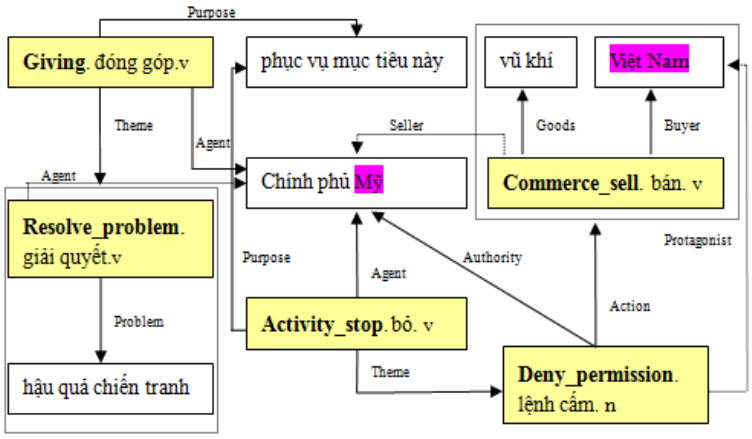

Fig. 5. KDG of example sentence (3)

5 Conclusion

This paper elucidates that our Domain-oriented Multilingual Frame Semantic Representation Model can take advantage of existing virtues from different FrameNets, highlighting the systematicness and hierarchy of semantic frames. On this basis, we built a Domain-oriented Vietnamese-English-Chinese FrameNet, implemented an organic collocation and combination of three languages in the same semantic frame.

Currently, 30 frames, 400 lexical units, and 210 annotated sentences are obtained as a result of DOV-E-CFN. The scale of DOV-E-CFN is not big enough to support the event extraction application, but the feasibility demonstration that frame semantic annotation can be applied in event extraction has been fully demonstrated[14].

Further research will concern expanding the number of annotated example sentences, exploring the automatic generation of KDG for complex sentences in news corpus. In addition, we will transfer above research productions to other suitable oriental languages like Malay, Thai, Japanese, and so on.

References

1. Fillmore, C.J., A Frames Approach to Semantic analysis[C]. In The Oxford Handbook of Linguistic Analysis, B. Heine and H. Narrog, eds., pp. 313-340, Oxford University Press, 2009.
2. Fillmore, C.J., Russell R. Lee-Goldman, and Rus-sell Rhodes .The FrameNet Constructicon [A].Hans C. Boas, Ivan A. Sag.Sign-based Construction Grammar [C]. Stanford: CSLI Publications, 2011.
3. Boas, Hans C. (ed.). Multilingual FrameNets in Computational Lexicography: Methods and Appli-cations[M]. Mouton de Gruyter. Berlin. 2009.
4. Mohit, Behrang, Srini Narayanan. Semantic ex-traction with wide-coverage lexical re-sources[C]. In Proceedings of the 2003 Conference of the North American Chapter of the Association for Computational Linguistics on Human Language Technology: companion volume of the Proceedings of HLT-NAACL 2003--short papers-Volume 2. Association for Computational Linguistics, 2003: 64-66.
5. Kaiying LIU. Reseach on Chinese FrameNet Con-struction and Application technolo-gies[J]. Journal of Chinese Information Processing, 2011(6): 47.
6. Ohara, Kyoko Hirose. Toward Constructicon Building for Japanese in Japanese FrameNet[J]. In Veredas On-Line - Frame Semantics and its tech-nological applications. Vol. 17, No. 1. PPG LINGUISTICA/UFJF-JUIZ DE FORA. 2013: 13.
7. Dhanon LEENOI et al.Manifesting Thai Concep-tual Scenarios through Thai FrameNet[C]. 7th In-ternational Conference on Natural Language Pro-cessing and Knowledge Engineering, NLPKE 2011, Tokushima, Japan, November 27-29, 2011:27-29.
8. Li LIN and Yude BI. A Frame Semantics Analysis of the Giving-type Verbs in Vietnam-ese[J]. Journal of PLA University of Foreign Languages, 2012(2): 42-46.
9. Alifu•KUERBAN, Wumaierjiang•KUERBAN, Dingyi FANG. Conceptual Design of Uy-ghur FrameNet[J]. Journal of Chinese Information Pro-cessing, 2013(2): 41-46.
10. Liping YOU, Tao LIU and Kaiying LIU. Re-search on the Chinese FrameNet[C]. ConstructionNationality Language and Characters Information Research Technology—Proceedings in Eleventh National Information Academic Symposium on Nationality Lan-guage and Characters, 2007: 453-461.
11. Fillmore, C.J., Collin F. Baker, and Hiroaki Sato. Seeing Arguments through Transparent Struc-tures[C]. Proceedings of the Third International Conference on Languag Resources and Evaluation. Vol. III. Las Palmas: LREC, 2002: 787-791.
12. Fillmore, C.J., Josef Ruppenhofer, and Collin F. Baker. FrameNet and Representing the Link be-tween Semantic and Syntactic Relations Computational Linguistics and Be-yond[C]. Eds. Chu-ren Huang, and Winifred Lenders. Language and Linguistics Mono-graphs Series B. Taipei: Institute of Linguistics, Academia Sinica, 2004: 19-62.
13. Fillmore, C.J., Srini Narayanan, and Collin F. Baker, What can linguistics contribute to event ex-traction[C]. In Proceedings of the 2006 AAAI Workshop on Event Extraction and Synthesis, 2006: 18-23.
14. Li LIN. A Study on Vietnamese Frame Semantic Annotation Based on the News Cor-pus[J]. Journal of Chinese Information Processing, 2013(6): 201-208.