Identification of Intention from Natural Language Text: an Inference Approach

Sirichai Triamlumlerd, Jeremy Ellman, Paul Vickers, and Maia Angelova

School of Computing, Engineering, and Information Sciences (CEIS), Northumbria University, Newcastle upon Tyne, UK

***Abstract*—We describe a novel computer model to analyse people's intention and purpose from ordinary language texts in the legal domain. Recognising people's intentions emphasises assault actions expressed by verbs of assault such as 'hit', 'attack', and the like. The input texts are taken from Westlaw UK, an online legal database. By exploiting inference techniques, the intentional actions of participants and their purpose are identified as whether an intentional assault and being self-defence, respectively. The system has achieved 80% accuracy over a number of actual case reports.**

Keywords: Intention Analysis; Text Mining; Artificial Intelligence and Law

I. INTRODUCTION

The word 'intention' in English criminal law is defined by Lord Diplock as the state of mind of willingness to produce the particular evil consequence [1]. However, analysing the state of mind cannot be directly conducted since it is an inner property of each person. Duff [1] also stated "The courts in Moloney and Hancock and Shankland talked of how we may infer an agent's intentions from his foresight of the natural consequences of his actions". Moreover, lawyers generally consent that an agent's mental states must always be inferred from the external evidence [1]. Accordingly, this paper defines intention analysis as the natural language process used to determine the offensive behaviour which is reflected to the state of mind the intention of participants in a certain fighting case.

Intention analysis is especially relevant to the legal domain, which will be the focus of this work. This domain is challenging and subject to argument and interpretation even by highly literate legal professionals. The legal domain also impacts on ordinary people. Consequently, automatic analysis techniques are potentially useful in the legal discovery process, or in investigating case law.

When considering intention, the question of purpose is usually raised. The fact is that one action may be composed of many purposes. Analysing a particular purpose requires individual supporting details corresponding to the action. For instance, when one person attacks another, various contingencies of purposes can be: robbery, when the former has taken the latter's belongings; rape, when the former has forcefully had sex with the latter without the consent of the latter; self-defence, when the latter has sensibly retaliated to the former; and so forth. With regard to such various purposes, this paper only emphasises analysing the purpose of self-defence.

The aim of this work is to use Natural Language Processing (NLP) techniques to identify the intention of offence and its purpose. The identification process is based on an inference technique since distinguishing inner mental state from external behaviour must be completed by inferring the latter from the former [1]. The key information used to infer the intention of offence is composed of three elements: a verb of assault, the item used, and the part of body involved. Meanwhile, the process of analysing the purpose can be accomplished based upon the notion of proportionality. The ultimate result could be taken into account as supportive information for judicial system.

The intention analysis problem is broader than work in word sense disambiguation [2], since in 'He hit the claimant a single blow on the side of the head' [3] 'hit' is not ambiguous. 'Hit' is used in the same sense regardless of whether the purpose of the action is assault or self-defence. However, the interpretation of the action may be found from the surrounding text. That is, since people may make appropriate determinations from the text, it should be possible to design a program to do the same.

In criminal cases, an action knowingly done with consciousness is considered as an intentional action. Therefore, all assault actions are held to be intentional offences.

Section II will first look at some background and previous work in NLP. Sections III and IV propose the concept used and the design of the model, respectively. Experimental evaluation on real-criminal cases is illustrated in section V. Finally, section VI offers conclusions.

II. BACKGROUND

Text processing is a current active research area due to the ready availability of large volumes of text over the Internet, the power of modern computers to process it, and the comparative time and expense of human text analysis. A text processing system is composed of several modules which are designed for specific purposes. These include sentence recognition [4][5], paragraph identification [6][7], part of speech tagging [8][9], semantic analysis [10], co-reference analysis [11][12], and information extraction [13][14]. However, since this work requires several NLP modules an understanding of relevant research is clearly indicated.

Looking at research in artificial intelligence and law, most active research is focused on two approaches based on legal documents: story-based and argument-based approaches. In an argument-based approach, McCarty [19] showed how a state-of-the-art statistical parser can handle the complex syntactic constructions of an appellate court judge and that a deep semantic interpretation of the full text could be computed automatically to extract judicial opinion from the output of the parser. Palau and Moens [20] demonstrated an approach to argumentation mining by using machine learning together with context-free grammars techniques. In a story-based approach, Keppens and Schafer [21] modelled a decision support system, an expert system, for synthesising a crime scenario to support a crime investigation. Thagard [22] demonstrated an analysis of jury decision making as kind of causal inference on two computational models: explanatory coherence and Bayesian

networks. Moreover, a hybrid theory of reasoning, the combination of story-based and argument-based approaches, was proposed by Bex et al. [23][24].

Although a variety of NLP modules are proposed, they are designed for a specific purpose, and separately created. Integrating them into one system tends to be a time-consuming and difficult task since their input and output format are different standard format. To avoid such problem, text pre-processing modules chosen in this paper is Sheffield University's GATE [25], a text engineering tool integrating and incorporating various specific NLP tools, e.g., LingPipe, OpenNLP, and so on. GATE's output is XML metadata, from which information such as verb, subject, object, etc. may be extracted. A Python driver program is required to complete the system. Python's Natural Language Toolkit (NLTK) [26] is also used as this links to a programmable inference module Prover9 [27] used to identify the intention of offence.

III. CONCEPT

A. Identification of intention of offence

Identifying the intention of an offence is a process of identifying the level of assault of each participant's action constituted by verb, item used and body part. The level of assault in this work is divided into three levels of action: fatal assault, assault, and normal action. If a participant's action is identified as an assault or a fatal assault then it is deemed to be an intentional offence, whereas a normal action is not. This claim is derived from the consent of lawyers mentioned earlier as the mental state must be inferred from external evidence, the participant's action in this paper.

Looking at verbs of assault, it is found that some verbs are more likely imply a fatal assault such as 'shot', 'stab', 'choke' and the like. Thus, whenever system finds a participant in the text producing an action by such verbs, it treats the action as a fatal assault. However, some verbs of assault e.g., hit, kick, punch, and so forth can be counted either as a fatal assault or an assault which is subject to the context of circumstance. For example, when a person hit another person, it means the former carries out an assault action whereas a person hit another person with newspaper or with a bottle means the former produces no harm action or assault action, respectively. It is clearly seen that if the action in question is applied with an item, the process of identifying an offence must take an additional component (the tem used) into consideration rather than focusing only on the verbs.

Experientially, the item used in the incident is one of the important variables because it can increase or decrease the degree of force when considered together with some verbs of assault, for instance hit, use, and so on. However, in some cases, the item itself can naturally illustrate a dangerous circumstance when interpreted even with general verbs e.g. use, point, aim, and the like. For example, in a certain incident, a person points a gun at another person. The former's action is undoubtedly considered as producing a deadly risk situation while the verb "point" is not an assault verb at all. Therefore, the system takes account of any participants who use any weapons in a certain incident as a person who produces a fatal assault because the item categorised as weapon can cause death.

Another interesting issue is that a general item, e.g., stone, iron, glass, and the like, can also be used to harm people, although it is not considered as a weapon in nature and not by the verb of assault. For example, a person throws a stone at another person. Accordingly, the system has to categorise such general items as probable weapons. Therefore, a participant's action, e.g., throw, fling, chafe, grate, carried out with any probable weapons is taken into account as an assault.

When fighting is concerned, a body part is always involved. Although some incidents do not mention a body part, (for instance, a person hit another person) some part of the body is hit. Accordingly, whenever the body part attacked is mentioned in the incident, it plays a key role for identifying the level of harm. For example, kicking a person on the leg means an assault whereas kicking a person in the head may cause the victim a grievous harm which leads to a fatal assault. Therefore, the system takes account of any assaults aimed at critical parts of body if they appear in the text, e.g. eye, neck, head, and the like, as a fatal assault; and if the body part is not mentioned, the level of harm is dependent on the verb and the item.

Identifying the level of assault is a process of inferring participants' actions from the written description as being one of fatal assault, assault, and normal action. These levels can be used to represent whether or not there was intent. Fatal assault and assault levels are classified as intentional actions whereas normal action is not. Moreover, by using the three level classifications, the concept of using proportionality can be applied to find out the purpose of self-defence corresponding to the action.

The inference can be processed by using a logical inference module which requires two arguments as inputs: assumption and goal. Both inputs are in the form of first order logic (FOL). The assumption is a set of rules which is used as knowledge for proving whereas the goal is a set of expressions required to be proved, the three levels of assault in this case.

Regarding the assumption, it is divided into two groups of information: ontological and knowledge of actual circumstance. Ontological knowledge is a set of implication rules. Each rule incorporates a condition (left hand side) and its implication (right hand side) for example, *all x all y all z(Person(x) & Person(y) & x!=y & attack(x,y) -> Assault(x))*. Real circumstance knowledge is a set of FOL expressions which are collected and converted from the real circumstance in written text. For instance, *exists x exists y (Victim(x) & Appellant(y) & x!=y & attack(x,y))* is derived from '*The appellant said that the victim attacked appellant* ...'. Once the assumptions are proved against the goal, the binary inference resolution of the goal will be given (if the goal is logically proved as true to the assumption) as a level of assault for a particular participant.

B. Justification

Justification in this work is a process of analysing the self-defence purpose of participants' actions. In the justice system, not only the actions of participants are required for a judge or jury to arrive at a verdict, but the purposes corresponding to the actions are also necessary. Specifically, self-defence (if found) leads to a full acquittal [28]. However, determining self-defence involves many elements such as proportionality, necessity, duty to retreat, and so on. This work only considers proportionality as a justification of purpose.

Proportionality is the relative degree of force used by participants. For self-defence, 'the amount of force used by a defendant must be judged objectively' [28, p.435]. However, the objective judgement is based upon various issues such as size, skill, degree of force, and the likes of participants. Accordingly, the judgement of proportionality in this paper focuses only on the degree of force, the level of assault, and ignores other irrelevant issues, since the degree of force can be inferred from the participants' action which usually appears in criminal cases, while other issues may or may not be stated in the cases. This work divides the level of assault into three categories: fatal assault (die or severely injured), assault (wounded), and normal action (not injured).

The main idea for justifying the purpose is derived from the fact that a self-defence action always occurs after an offensive or dangerous action carried out by another person. Furthermore, in terms of proportionality, the level of assault of the self-defence action must be at least equal or lower (lighter) than the preceding actions produced by another. In order to compare the level of assault between particular two actions bearing in mind that the actions have been identified as one of the three levels of assault in the earlier state, the levels must be assigned numerical values as shown in table I.

TABLE I. ASSIGNING NUMERICAL VALUE FOR LEVEL OF ASSAULT

Level of Assault	Value
Fatal Assault	3
Assault	2
Normal Action	1

Taking account of comparing values of level of assault of any two actions, differentiation of the values (called the proportionality value) can be range from 2 to -2, calculated by value of a person action minus value of the other's action. For instance, person A carries out an action inferred as fatal assault (value 3) on person B and then person B carries out an action inferred as normal action (value 1) on person A which gives a proportionality value 3-1 = 2. Alternatively, person A acts normally (1) to person B and whilst person B produces a fatal action (3) which give a proportionality value of 1-3 = -2. Thus, the contingency of proportionality values and their corresponding categories of self-defence can be as illustrated in Table II.

According to the contingency of proportionality values in Table II, the self-defence purpose can be divided into four categories. The proportionality values 2, 1, and 0 are categorised as Self-defence, May be self-defence, and Might be self-defence respectively. The distinction between 'May be' and 'Might be' self-defence is that 'May be' self-defence takes higher possibility of self-defence than 'Might be' self-defence. Meanwhile proportionality values less than 0 fall into the category of No Self-defence, since level of assault value of retaliated action is greater than the initial action's.

TABLE II. CONTINGENCY OF PROPORTIONALITY VALUES AND CORRESPONDING SELF-DEFENCE PURPOSES

Category of Self-defense purpose	Proportionality Value
Self-defence	2
May be self-defence	1
Might be self-defence	0
No self-defence	< 0

IV. MODEL DESIGN

The model of identifying people's intention in this paper takes legal proceedings as an input and ultimately provides supportive information for the justice procedure in terms of who intentionally harms whom by what action and whether the purpose was self-defence. This section explores how the model is designed and processed on the real case example.

A. Design

Beginning with the input text of the system, criminal proceedings from WestLaw UK [29] are chosen for input because of the consistency of writing style. Nevertheless, a variety of criminal cases exists. This work deals only with the case of altercation or assault between two participants whose status is not, for example, authorities, juvenile, and so on, since their cases require specific judgement. Moreover, cases dealing with defence of other or defence of property are omitted because they require various aspects of information e.g. location, time, relationship among participants, and so forth which exceeds the limited framework of this work.

Most semantic analysis tasks require natural language pre-processing to achieve linguistically fundamental information. Likewise, this work requires the following pre-processing modules: sentence tokenizer, word tokentizer, Part of Speech (POS) tagging, Named Entity Recognition (NER), Co-reference resolution, and Predicate Argument (PA) extraction. All pre-processing modules use GATE.

As this work exploits the principle of inference to identify intention from action, all sentences have to be in logical form, as PA expressions. Although the process of PA extraction has been executed by GATE, the output of GATE execution, an annotated XML format, cannot be used in the inference process. Hence, a module to generate PA expressions for each sentence from the XML file is required. Moreover, significant information such as negation and preposition phrase has to be extracted from the XML file and put into PA expression because missing negation causes incorrect interpretation of action while missing preposition phrase brings about a lack of body part information required for the identification of intention. Finally, in generating PA expressions subjective and objective pronouns have to be replaced with proper names or roles (e.g. victim, appellant) since in the process of inference, pronouns (e.g. he, she, her, him, etc.) cannot be linked to a specific person.

Once the PA expressions are generated, the PA expressions relevant to actions bringing about the incident are selected for the inference process. The selection is processed by filtering raw sentences containing key words and then only PA expressions corresponding to the filtered sentences are chosen. The key words used for sentence filtering are verbs of assault and a weapon list. The verbs of assault list is derived from lexical units in FrameNet's cause_harm frame [30] and then populated further using WordNet [31]. The weapon list is collected from WordNet by focusing on hyponyms of the word 'weapon'. Furthermore, hyponyms of the word 'weapon' may have more than one hypernym (not only weapon), for instance 'knife' is a weapon and also an 'edge tool' (any cutting tool with a sharp cutting edge). So, the coordinate term function used for finding the words sharing the same hypernym of a particular word is used to gain the number of words in the weapon list. However, PA expressions lack quantifier terms which can support more precisely the inference process. So,

all PA expressions are transformed into FOL expressions which must be part of the assumption in the inference process.

The inference process to identify intention of actions uses the Prover9 module. This requires two components, assumption and goal, to provide a binary inference result. Assumption is a set of logical expressions acting as a repository of knowledge established from two parts: ontological assumption and real circumstance assumption. The ontological assumption contains rules implying that, e.g., an action carried out a person on another person is an assault as shown in figure 5, whereas the real circumstance assumption is composed of FOL expressions shown in figure 3 derived from selected content of the input text shown in figure 2. Goal is a set of FOL expressions expressing the existence of a participant and his/her intention of offence represented as level of assault shown in figure 4. It is used as a question sent to Prover9 in order to prove the truth of the goal against the assumption.

When all actions have had their level of assault determined, each action must also be analysed to identify the purpose of self-defence. Analysing the purpose of self-defence can be fulfilled by comparing the level of assault of each action achieved from the proof process. The possible outcomes of the analysis can be divided into four categories of self-defence purpose as shown in Table II. The model of the whole system is illustrated in Fig. 1.

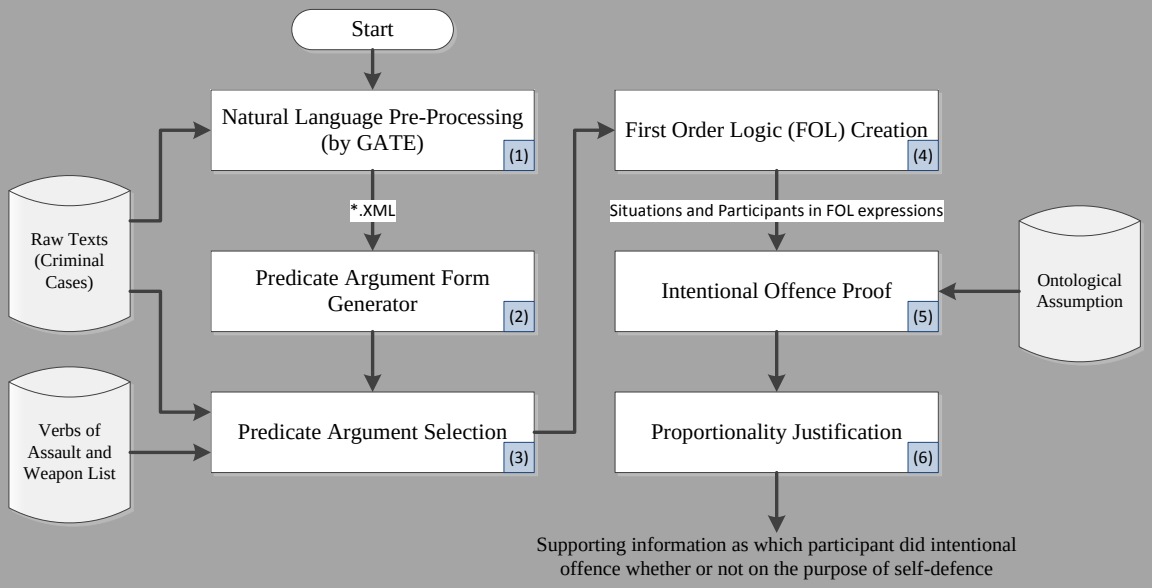

Figure 1. Model for inditifying people's intention and purpose from legal proceedings

B. *Model Processing Demonstration*

In order to understand how intention and purpose are analysed from a text, an extract of a criminal case report [32] is given in Fig 2. This is an input to the system through which the case is processed.

The appellant described in her evidence a difficult relationship. She said that she had previously been visited with violence and that on the night in question the aggression came from her partner. The victim had accused her of sleeping with somebody else. The victim grabbed her by the throat. The victim pushed her and hit her in the chest. The victim had her hand on her throat. She tried to calm him down but he would not be calmed. To protect herself she went to the kitchen. She picked up a small, sharp, black handled knife. She held it in her right hand: Come on then, he responded and do it, and she moved the knife to make him stand back, but he came towards her. The appellant said she accidentally cut him at arm because she did not mean to cut him. She said that the victim attacked her. The victim punched her in the head. The victim kicked her stomach and there was scuffling on the floor when he was cut in the chest. She had been advised to make no comment once the police came to the house.

Figure 2. Partial part of a criminal case as an input of the model

Once the input case shown in Fig. 2 has been prepared it is sent to the pre-processing module (Fig. 1 (1)), to annotate significant linguistic information in XML format. PA form Generator (Fig. 1 (2)) creates PA expressions of each sentence from the XML file. All created PA expressions are sent to PA Selection (Fig. 1 (3)) to filter only interesting PA expressions.

During the filter process, sentences in Fig. 2 containing a word matching to a word in verbs of assault and the weapon list are filtered and then only PA expressions corresponding to the filtered sentences are selected. The selected PA expressions are sent to FOL Creation (Fig. 1 (4)) to transform PA expressions into FOL expressions as shown in Fig. 3. This set of expressions is part of assumption used for the proving process (Fig. 1 (5)).

1:exists x y p1.(((((Victim(x) & Appel(y)) & -(x = y)) & grab(x,y)) & Throat(p1)) & By(p1))
2:exists x y p1.(((((Victim(x) & Appel(y)) & -(x = y)) & hit(x,y)) & Chest(p1)) & In(p1))
3:exists x y.(((Victim(x) & Appel(y)) & -(x = y)) & push(x,y))
4:exists x y.(((Victim(x) & Knif(y)) & -(x = y)) & pick(x,y))
5:exists x y p1.(((((Victim(x) & Appel(y)) & -(x = y)) & cam(x,y)) & Appel(p1)) & Toward(p1))
6:exists x y.(((Victim(x) & It(y)) & -(x = y)) & do(x,y))
7:exists x y p1.(((((Victim(x) & It(y)) & -(x = y)) & held(x,y)) & Hand(p1)) & In(p1))
8:exists x y.(((Victim(x) & Knif(y)) & -(x = y)) & mov(x,y))
9:exists x.(Victim(x) & Respond(x))
10:exists x.(Victim(x) & Stand(x))
11:exists x.(Appel(x) & -mean(x))
12:exists x y.(((Appel(x) & Victim(y)) & -(x = y)) & cut(x,y))
13:exists x.(Appel(x) & Said(x))
14:exists x y.(((Victim(x) & Appel(y)) & -(x = y)) & attack(x,y))
15:exists x.(Appel(x) & Said(x))
16:exists x y p1.(((((Victim(x) & Appel(y)) & -(x = y)) & punch(x,y)) & *Head(p1)) & In(p1))*
17:exists x y.(((Victim(x) & Stomach(y)) & -(x = y)) & kick(x,y))
18:exists x y p1.(((((Ther(x) & Flo(y)) & -(x = y)) & scuffl(x,y)) & Flo(p1)) & On(p1))
19:exists x y.(((Victim(x) & Cut(y)) & -(x = y)) & was(x,y))

Figure 3. Selected FOL expressions as an agent of circumstance

As previously mentioned, the assumption comprises ontological and real circumstance assumption in a logical form, the latter is shown in Fig. 3, meanwhile partial part of the former is illustrated in Fig. 4. The ontological assumption is manually prepared and required to be appended when dealing with circumstance containing unseen verb of assault, weapon, and part of body. However, implication of named entities, line 12 and 13 in Fig. 4, is automatically and individually created for each case with respect to the number of participants appearing in a case.

```
1:all x all y all z(Person(x) & Person(y) & x!=y & Critical_part(z) & grab(x,y) & Prep(z) -> Fatal_assault(x)).
2:all x all y all z(Person(x) & Person(y) & x!=y & Nomal_part(z) & hit(x,y) & Prep(z) -> Assault(x)).
3:all x all y(Person(x) & Person(y) & x!=y & push(x,y) -> Normal_act(x)).
4:all x all y all z(Person(x) & Person(y) & x!=y & cut(x,y) -> Fatal_assault(x)).
5:all x all y all z(Person(x) & Person(y) & x!=y & attack(x,y) -> Assault(x)).
6:all x all y all z(Person(x) & Person(y) & x!=y & Critical_part(z) & punch(x,y) & Prep(z) -> Assault(x)).
7:In(x) | On(x) | At(x) | To(x) | With(x) | By(x) | Across(x) | Around(x) |
8:Under(x) -> Prep(x).
9:Head(x) -> Critical_part(x).
10:Throat(x) -> Critial_part(x).
11:Chest(x) -> Normal_part(x).
12:Appel(x) -> Person(x).
13:Victim(x) -> Person(x).
```

Figure 4. Partial part of ontological knowledge assumption

The proof process (Fig. 1 (5)) requires a certain set of goals to be proved with assumption, the combination of logical expression from Fig. 3 and 4. The number of the goal sets is subject to the number of participants appearing in a case. Hence, two sets of goals in respect of the context in Fig. 2 are automatically generated as shown in Fig. 5.

exists x(Victim(x) & Fatal_assault(x)). *exists x(Victim(x) & Assault(x)).* *exists x(Victim(x) & Normal_act(x)).*	*exists x(Appel(x) & Fatal_assault(x)).* *exists x(Appel(x) & Assault(x)).* *exists x(Appel(x) & Normal_act(x)).*
(a)	*(b)*

Figure 5. (a) set of goals for proving victim's level of assault,
(b) set of goals for proving appeallant's level of assault

```
********** Justification of each circumstance **********
1: Victim grabbed appellant by throat which is considered as an intentional offence. There is no exception for self-defense because the Victim had firstly started the incident.
2: Victim hit appellant in chest which is considered as an intentional offence. There is no exception for self-defense because the Victim had firstly started the incident.
3: Victim pushed appellant which cannot be considered as an offence.
4: Appellant cut victim which is considered as an intentional offence. This action might be considered as being self-defense because earlier, victim grabbed appellant by throat
5: Victim attacked appellant which is considered as an intentional offence. This action may be considered as being self-defense because earlier, appellant cut victim However, there was earlier at least an intentional offence as victim hit appellant in chest with no exception of being self-defense.
6: Victim punched appellant in head which is considered as an intentional offence. This action may be considered as being self-defense because earlier, appellant cut victim However, there was earlier at least an intentional offence as victim hit appellant in chest with no exception of being self-defense.

##########################Conclusion#########################
1: Appellant cut victim which is considered as an intentional offence. This action might be considered as being self-defense because earlier, victim grabbed appellant by throat
2: Victim grabbed appellant by throat which is considered as an intentional offence. There is no exception for self-defense because the Victim had firstly started the incident.
```

Figure 6. Result of self-defense purpose analysis on participants' actions

In this case as represented by FOL expression in Fig. 3, the expressions lines 1-3, 14, 16 are proved as true on goals in Fig. 5(a) corresponding to assumptions in Fig. 4 lines 1-3, 5, 6, respectively, meanwhile the expression line 12 is proved as true on goals in Fig. 5(b) corresponding to the assumption line 4.

Once one of the levels of assault is assigned to each action proved as true, proportionality justification (Fig. 1 (6)) is processed and the result of purpose of self-defence of each action is displayed in Fig. 6. However, a participant may produce more than one action in context. Therefore, one of each participant's actions in Fig. 6 is chosen as a representative of their actions. The representative actions are selected with respect to the most value of the level of assault (see table I) and the order of actions.

V. EXPERIMENTAL EVALUATION

A preliminary experiment in this paper was conducted on twenty appeal court cases. The reason of the less number of the cases is that collecting self-defence cases regarding the criterions as mentioned before in the first paragraph of section IV (A) is time consuming. The appeals were all made on the grounds of self-defence. Therefore, the experiment focuses on the accuracy of justification on self-defence rather than intention of offence, since in most criminal cases, participants' actions are considered as intention.

Prior to the processing of each case, a preparation of an input case is required. Generally, legal cases are titled with initial relevant information such as case name, court, kind of case, and the like. These are removed to reduce irrelevant details. Furthermore, three issues of manually sequential modification are still required. Firstly, focused parts of text have to be selected. This work is a story-based approach which does not deal with other information such as arguments of the judges, juries, and specific circumstances of other cases, which may cause confusion to the system (a crossed situation problem). Secondly, in case that a participant's name is not in the system's database, the name must be added into the name list in order to let the system recognise the name in the current and future cases. Thirdly, the some sentences may need to have their order swapped in order to achieve the actual temporal sequence of circumstances, since incidents in some cases may be explained in different orders of time.

The proof of experiment is based on verdict of each case. In the end of the cases, their verdicts were quashed. The quashing verdict upholds that the appellant's action in the case is self-defence. This result can be used to evaluate the system's justification. The evaluation can be accomplished by comparing the quashing verdict to the conclusion of the representative action of the appellant. If the representative action is considered as one of the self-defence purposes except "No Self-defence" (see table II) then the analysis on self-defence purpose of the system is correct. The experiment on twenty cases including the example case demonstrated in section IV (B) gives the correct outcome in 16 out of 20 cases, or 80% accuracy.

VI. CONCLUSION

We have described a novel computer model to determine whether an individual's intention behind a violent action was to commit an act of assault, or whether the action was in self-defence. The model processes data from actual court reports from Westlaw, an established legal database. It

incorporates two main parts, identifying intention of offence and justifying purpose of self-defence. The preliminary experiment shows a promising result of 80% accuracy.

In future work, our target is about having an experiment on at least 100 cases in order to ensure the accuracy of the model. Moreover, reducing the manual process of input preparation is also our engagement.

REFERENCES

[1] DUFF, R. A. (1990) Intention, Agency and Criminal Liability: Philosophy of Action and the Criminal Law, Oxford, Basil Blackwell Ltd.

[2] NAVIGLI, R. (2009) Word sense disambiguation: A survey. ACM Comput. Surv., 41, 1-69.

[3] (2000) Harry Cross v William Dickinson Kirkby. Court of Appeal.

[4] HINOSHITA, W., ARIE, H., TANI, J., OGATA, T. & OKUNO, H. G. (2010) Recognition and generation of sentences through self-organizing linguistic hierarchy

[5] DILEK, H. T. & GOKHAN, T. (2007) Statistical sentence extraction for information distillation. 2007 IEEE International Conference on Acoustics, Speech, and Signal Processing, 4, 1-4.

[6] GENZEL, D. (2005) A paragraph boundary detection system. Proceedings of the 6th international conference on Computational Linguistics and Intelligent Text

[7] CAROLINE, S. & MIRELLA, L. (2006) Broad coverage paragraph segmentation across languages and domains. ACM Transactions on Speech and Language Processing (TSLP), 3, 1-35.

[8] GADDE, P., SUBRAMANIAM, L. V. & FARUQUIE, T. A. (2011) Adapting a WSJ trained part-of-speech tagger to noisy text: preliminary results. Proceedings of the 2011 Joint Workshop on Multilingual OCR and Analytics for Noisy Unstructured Text Data.

[9] BIEMANN, C. (2009) Unsupervised Part-of-Speech Tagging in the Large. Res. Lang. Comput., 7, 101-135.

[10] KIM, Y. B. & KIM, Y. S. (2010) An autonomous assessment system based on combined latent semantic kernels. Expert Syst. Appl., 37, 3219-3228.

[11] KOLYA, A. K., DAS, D., EKBAL, A. & BANDYOPADHYAY, S. (2011) Identifying event: sentiment association using lexical equivalence and co-reference approaches. Proceedings of the ACL 2011 Workshop on Relational Models of Semantics.

[12] YANG, Y., SINGH, P., YAO, J., YEUNG, C. M. A., ZAREIAN, A., WANG, X., CAI, Z., SALVADORES, M., GIBBINS, N., HALL, W. & SHADBOLT, N. (2011) Distributed human computation framework for linked data co-reference resolution. Proceedings of the 8th extended semantic web conference on The semantic web: research and applications - Volume Part I.

[13] WIMALASURIYA, D. C. & DOU, D. (2010) Components for information extraction: ontology-based information extractors and generic platforms. Proceedings of the 19th ACM international conference on Information and knowledge management.

[14] KARKALETSIS, V., FRAGKOU, P., PETASIS, G. & IOSIF, E. (2011) Ontology based information extraction from text. IN GEORGIOS, P., CONSTANTINE, D. S. & GEORGE, T.

[15] DURIC, A. & SONG, F. (2011) Feature selection for sentiment analysis based on content and syntax models. Proceedings of the 2nd Workshop on Computational Approaches to Subjectivity and Sentiment Analysis.

[16] THET, T. T., NA, J. C. & KHOO, C. S. G. (2010) Aspect-based sentiment analysis of movie reviews on discussion boards. J. Inf. Sci., 36, 823-848.

[17] WU, S. (2012) Applying the data fusion technique to blog opinion retrieval. Expert Syst. Appl., 39, 1346-1353.

[18] JAKOB, N. & GUREVYCH, I. (2010) Using anaphora resolution to improve opinion target identification in movie reviews. Proceedings of the ACL 2010 Conference Short Papers.

[19] MCCARTY, L. T. (2007) Deep semantic interpretations of legal texts. Proceedings of the 11th international conference on Artificial intelligence and law, 217-224.

[20] MOCHALES, R. & MOENS, M. F. (2011) Argumentation mining. Artif. Intell. Law, 19, 1-22.

[21] KEPPENS, J. & SCHAFER, B. (2006) Knowledge based crime scenario modelling. Expert Syst. Appl., 30, 203-222.

[22] THAGARD, P. (2004) Causal Inference in Legal Decision Making: Explanatory Coherence vs Bayesian Networks. Applied Artificial Intelligence, 18, 231-249.

[23] BEX, F. & VERHEIJ, B. (2011) Legal shifts in the process of proof. Proceedings of the 13th International Conference on Artificial Intelligence and Law.

[24] BEX, F., VAN KOPPEN, P., PRAKKEN, H. & VERHEIJ, B. (2010) A hybrid formal theory of arguments, stories and criminal evidence. Artificial Intelligence and Law, 18, 123-152.

[25] CUNNINGHAM, H., et al. (2011) Text Processing with GATE (Version 6). University of Sheffield Department of Computer Science.

[26] BIRD, S. (2012) NLTK: The Natural Language Toolkit.

[27] MCCUNE, W. W. (2005-2012) Prover9 and Mace4.

[28] MCALHONE, C. & HUXLEY-BINNS, R. (2010) Criminal Law The Fundamentals, London, Tomson Reuters (Legal) Limited.

[29] SWEET & MAXWELL LIMITED (2010) WESTLAW UK.

[30] BERKELEY FRAMENET PROJECT (2012) FrameNet.

[31] FELLBAUM, C. (1998) WordNet: An Electronic Lexical Database. Cambridge, MA: MIT.

[32] (2008) Regina v Danielle Burden. Court of Appeal Criminal Division