# Affect Detection from Semantic and Metaphorical Interpretation of Virtual Drama

## [Extended Abstract]

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## ABSTRACT

We have developed an intelligent agent to engage with users in virtual drama improvisation previously. The agent was able to perform sentence-level affect detection especially from inputs with strong emotional indicators. In this research, we employ latent semantic analysis to interpret emotional expressions with vague affect indicators and ambiguous audiences. Latent semantic analysis is thus used to perform topic theme detection and target audience identification for such inputs. Then we also discuss how affect is detected for such inputs without strong emotional indicators with the consideration of emotions expressed by the intended audiences and relationships between speakers and audiences. This work also proves to be effective in recognizing metaphorical phenomena. Moreover, uncertainty-based active learning is also employed to deal with more open-ended and imbalanced affect detection tasks. Overall, this work enables the AI agent to deal with challenging issues in affect detection tasks.

## Categories and Subject Descriptors

D.3.3 [**Programming Languages**]: I.2.1 Applications and Expert Systems – *Games, Automation, Natural Interfaces.* I.2.7 Language Processing.

## Keywords

Affect detection, latent semantic analysis, and improvisation.

## 1. INTRODUCTION

It is a long-term research goal for human computer interaction to build human-like computer interfaces. This endeavour has given rise to agent-based user interfaces. Moreover, we believe it will make intelligent agents possess human-like behaviour and narrow the communicative gap between machines and human-beings if they are equipped to interpret human emotions during social interaction. Thus in this research, we equip our AI agent with emotion and social intelligence. According to Kappas [1], human emotions are psychological constructs with notoriously noisy, murky, and fuzzy boundaries that are compounded with contextual influences in experience and expression and individual differences. These natural features of emotion also make it difficult for a single modal recognition, such as via acoustic-prosodic features of speech or facial expressions. Since human being's reasoning process takes related context into consideration, in our research, we intend to make our agent take multi-channels of subtle emotional expressions embedded in social interaction contexts into consideration to draw reliable affect interpretation. The research presented here focuses on the production of intelligent agents with the abilities of interpreting dialogue contexts semantically to support affect detection as the first step of building a machine with emotion and social intelligence.

A previously developed online multi-user role-play virtual drama framework is employed for this research, which allows school children aged 14 – 16 to talk about emotionally difficult issues and perform drama performance training. In this platform young people could interact online in a 3D virtual drama stage with others under the guidance of a human director. In one session, up to five virtual characters are controlled on a virtual stage by human users ("actors"), with characters' (textual) "speeches" typed by the actors operating the characters. The actors are given a loose scenario around which to improvise, but are at liberty to be creative. An intelligent agent is also involved in improvisation. It included an affect detection component, which detected affect from human characters' each individual turn-taking input (an input contributed by an individual character at one time). This previous affect detection component was able to detect 15 emotions including basic and complex emotions and value judgments, but the detection processing has not taken any context into consideration. The intelligent agent made attempts to produce appropriate responses to help stimulate the improvisation based on the detected affect [2, 3].

This original affect detection processing was mainly built using pattern-matching rules that looked for simple grammatical patterns or templates partially involving specific words and their alternatives. From the analysis of the previously collected transcripts, the original affect interpretation without any contextual inference proved to be effective enough for those inputs containing strong clear emotional indictors such as 'yes/no', 'haha', 'thanks' etc. There are also situations that users' inputs do not have any obvious emotional indicators or contain very weak affect signals but carrying strong emotions, thus contextual inference is needed to further derive the affect conveyed in such user inputs.

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It is also noticed that in the collected transcripts the improvisational dialogues are often multi-threaded. This refers to the situation that social conversational responses of different discussion themes to previous several speakers are mixed up due to the nature of the online chat setting. Therefore the detection of the most related discussion theme context using semantic analysis is very crucial for the accurate interpretation of the emotions implied in those inputs with ambiguous target audiences and weak affect indicators.

The work presented here especially discusses how latent semantic analysis is used to deal with such challenging affect detection tasks. The presented semantic-based conversational theme detection approach also shows great potential in dealing with metaphor identification. Finally, we also briefly discuss how we can deal with more open-ended affect detection tasks beyond the constraints of the chosen scenarios using a min-margin based active learning.

## 2. SEMANTIC INTERPRETATION

The language used in our previously collected transcripts is often complex, idiosyncratic and invariably ungrammatical. Most importantly, the language also contains a large number of weak cues to the affect that is being expressed. These cues may be contradictory or they may work together to enable a stronger interpretation of the affective state. In order to build a reliable and robust analyser of affect it is necessary to undertake several diverse forms of analysis and to enable these to work together to build stronger interpretations. Therefore, in this study, we integrate contextual information to further derive the affect embedded in the contexts and to provide metaphor identification.

We mainly relied on keywords and partial phrases matching with simple semantic analysis using WordNet in our previous rule-based driven affect detection. However, we notice many terms, concepts and emotional expressions can be described in various ways. Especially if the inputs contain no strong affect indicators, other approaches focusing on underlying semantic structures in the data should be considered. Thus latent semantic analysis (LSA) [4] is employed to calculate semantic similarities between sentences to derive discussion themes for such inputs.

Latent semantic analysis generally identifies relationships between a set of documents and the terms they contain by producing a set of concepts related to the documents and terms. In order to compare the meanings behind the words, LSA maps both words and documents into a 'concept' space and performs comparison in this space. In detail, LSA assumes that there is some underlying latent semantic structure in the data which is partially obscured by the randomness of the word choice. This random choice of words also introduces noise into the word-concept relationship. LSA aims to find the smallest set of concepts that spans all the documents. It uses singular value decomposition to estimate the hidden concept space and to remove the noise. This concept space associates syntactically different but semantically similar terms and documents. We use these transformed terms and documents in the concept space for retrieval rather than the original ones.

In our work, we employ the semantic vectors package (http://code.google.com/p/semanticvectors/) to perform LSA, analyze underlying relationships between documents and calculate their similarities. This package provides APIs for concept space creation. It applies concept mapping algorithms to term-document matrices using Apache Lucene, a high-performance, full-featured text search engine library implemented in Java. We integrate this package with our AI agent's affect detection component to calculate the semantic similarities between user inputs without strong affect signals and training documents with clear discussion themes. Topics embedded in user inputs are derived from the above document similarity calculation and calculation of similarities between the inputs and predefined scenario related terms. The most intended audiences of the inputs are also identified by the topic theme detection. Context-based scenario-related appraisal rules are also generated to accept the most recent emotions expressed by the target audiences and relationships between the audiences and the speaker to derive affect embedded in the inputs with weak affect indicators.

Moreover, metaphorical language can be used to convey emotions implicitly and explicitly, which also inspires cognitive semanticists. Especially we notice some cooking and sensory metaphors with affective implication are sometimes used in the drama improvisation, e.g. "he is grilled by the teacher". We gather the following examples for the study of semantic and syntactical structures of such metaphorical expressions, including cooking metaphor: "the news inflamed her temper", "she was burned by a shady deal"; light metaphor: "you lighted up my life"; temperature metaphor: "they are kindling a new romance"; taste metaphor: "bittersweet memories" and smell metaphor: "love stinks". Implementation has been carried out to perform recognition of such metaphorical phenomena. For example, the above semantic-based topic theme detection processing is used to recognize the following disease metaphor, "this disease is dragging me down". The semantic processing recognizes this input has the highest semantic similarities to the mental metaphor corpus (0.788). It implies the disease has been regarded as being active outside of a living agent, which can carry out actions.

We also noticed that the collected transcripts contained imbalanced class categories, e.g. more negative inputs presented than positive and neutral ones. In order to improve the robustness and deal with imbalanced affect classifications, we have applied a min-margin based active learning method for affect detection. A margin sampling technique is used in order to select the most informative unlabelled instance, since it shows great performance in reducing classification error. The active learner is able to reach high accuracy with few unlabelled instances comparing with traditional supervised learning. Initial experiments also showed that the active learning method showed impressive performances when dealing with open-ended affect detection tasks without constraints of scenarios and imbalanced affect classifications.

## 3. REFERENCES


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