

Sentiment Analysis in Human-robot Interaction

PhD. Thesis Proposal
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Motivation

- Why we need sentiment analysis ?
- Increasing **accuracy** of current state of the art result of detecting emotions in text
- **Improvement** of human-robot/robot-human interaction (care of elderly)
- Ability **to adapt** and behave according to specific situations
- Scenarios: robots will tell children fairy with/without emotions

The State of the Art

Affective Computing and Human-robot Interaction

Emotion Detection in Text

System proposal

Goals of the Thesis

Sentiment analysis

- What is sentiment analysis ?
- Research Tasks in Sentiment Analysis :
 - opinion analysis:
 - subjectivity detection
 - polarity classification
 - intensity classification
 - opinion spam identification
 - **emotion** identification



Levels of Sentiment Analysis

- Can be done on varied levels such as:
 - **word/phrase** level sentiment analysis
 - **sentence** level sentiment analysis
 - **document** level sentiment analysis
 - **discussion** level sentiment analysis
- Aspect-Based Sentiment Analysis

Approaches towards Sentiment Analysis

- There are two approaches towards sentiment analysis:
 - the text classification approach:
 - machine learning methods
 - statistical methods
 - the lexicon-based approach:
 - lexical (perform poorly in different domains)
 - corpus based (expensive amounts of time).

Machine Learning and Statistical Methods

- used to decide which words are the most relevant for sentiment based upon a set of non-linguistic rules and a large set of pre-classified texts for training
- The **advantage** of not using a pre-defined lexicon is that non-sentiment terms may be identified by expressing a judgment
- The **disadvantage**:
 - they can introduce systematic anomalies by exploiting non-sentiment words
 - less transparent than lexical methods
 - training sets are necessary to be available

Machine Learning and Statistical Methods

- The Naive Bayes Classifier:
 - text categorization still tends to perform surprisingly well

$$P(c | d) = P(c) \prod_{1 \leq k \leq n_d} P(t_k | c)$$

- classifier then returns the class with the highest probability, given the document
- Maximum Entropy Classifier
- Support Vector Machine
- Decision Trees
- k-Nearest Neighbor
- Deep learning for sentiment analysis

Lexical and Corpus Based Methods

- Lexical Based Approach:
 - Bing Liu's Opinion Lexicon
 - Multi-Perspective Question Answering (MPQA) Subjectivity Lexicon
 - Linguistic Inquiry and Word Counts (LIWC)
 - Dictionary of Affect in Language
 - WordNet
 - SentiWordNet
 - Word-Emotion Association Lexicon
- Corpus Based Methods

Problems in Sentiment Analysis

- It is a very subjective method of classification and if there is more than one test observer, there will more than likely be differences in opinion
- Fraught with quotations
- Sarcasm
- Complex references to persons, organizations
- Annotations of words - crowdsourcing

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Goals of the Thesis

Affective Computing and Human-Robot Interaction

- Emotion is an essential role in decision making and learning
- Computers (and also robots) that interact naturally and intelligently with humans need at least the ability to recognize and express affect
- The study of interaction dynamics between humans and robots
- fundamental goal of HRI is to develop the principles and algorithms for robot systems that enable safe and effective interaction with humans

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Emotion Detection in Texts

- study of emotion is an essential aspect of the study of humankind
- To detect emotion, researchers use generally known algorithms created for sentiment analysis
- There are three major directions in affect computing are recognized:
 - categorical/discrete
 - dimensional
 - appraisals-based approaches

Emotion Detection in Texts

- **Categorical Approach:**
 - there are a small number of basic emotions that are hard-wired in our brain
 - a couple of researchers proved that people show non-basic, subtle and rather complex affective states that could be impossible to handle, such as thinking, embarrassment or depression
- **Dimensional Approach:**
 - Wundt's proposal that feelings (which he distinguishes from emotions) can be described as pleasantness–unpleasantness, excitement–inhibition and tension–relaxation
 - Osgood's work on the dimensions of affective meaning (arousal, valence, and potency)
- **Appraisals-based Approach:**
 - people's personal interpretations of an event in determining their emotional reaction
 - perceived attributes of situation (urgency: very high)

Emotion Detection in Texts

- **Categorical Approach:**

- Ekman's six basic emotions: anger, disgust, fear, happiness, sadness, surprised
- Cowie et al (17 emotions): affectionate, afraid, amused, angry, ...
- Fontaine, Scherer, Roesch and Ellsworth (24 emotions)
- Frijda (12 emotions): anger, arrogance, desire, disgust, enjoyment, fear, humility, indifference, interest, resignation, shock, surprise

- **Dimensional Approach:**

- Mehrabian: pleasure, arousal, and dominance
- Fontaine, Scherer, Roesch and Ellsworth: valency, potency, arousal, unpredictability

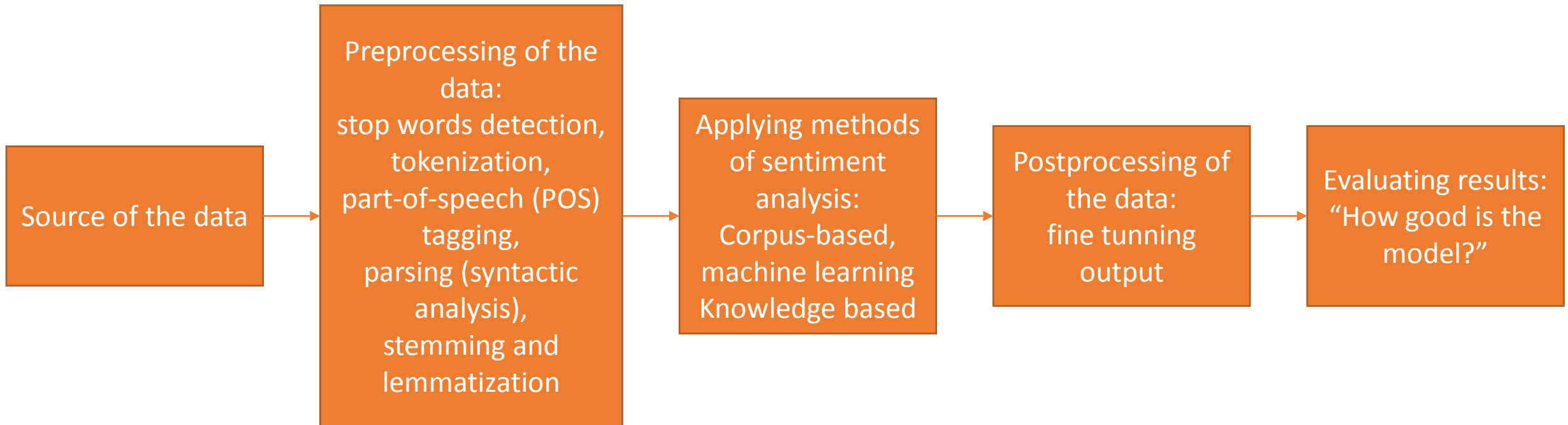
- **Appraisals-based Approach:**

- Ortony, Clore and Collins
- Scherer

Sentiment analysis in emotion detection

*(1) I am now trying to find words to describe this movie for an hour. (2) I couldn't. (3) You've seen it, or you haven't. (4) It's **monumental** and **outrageously good**. (5) The cast is **brilliant**. (6) The jokes **lovely**. (7) The story and the idea behind the movie is **beautiful**. (8) Especially when you've worked/lived with handicapped people. (9) The music is such a **perfect** choice, it is unbelievable. (10) I hope this movie makes a plenty of people think about how **good** their life is and how bad it could have been.*

System for Detecting Emotions in Text



Research

- Four major approaches to detecting emotions in text:
 - corpus-based methods
 - LiveJournal blog, Text Affect, Fairy Tales and Annotated blog
 - Newspaper and web news sites headlines (SemEval 2007) – 5 emotions
 - machine learning methods
 - Czech newspaper headlines – 6 emotions
 - Suicide notes – 15 emotions
 - knowledge-based methods
 - EmotiNet – 5 emotions

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Goals of the Thesis

Today is
sunny day...



Interaction

011110000
1010101...



Today is sunny day...



Black Box

CYBERSPACE



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Articles, News, ...

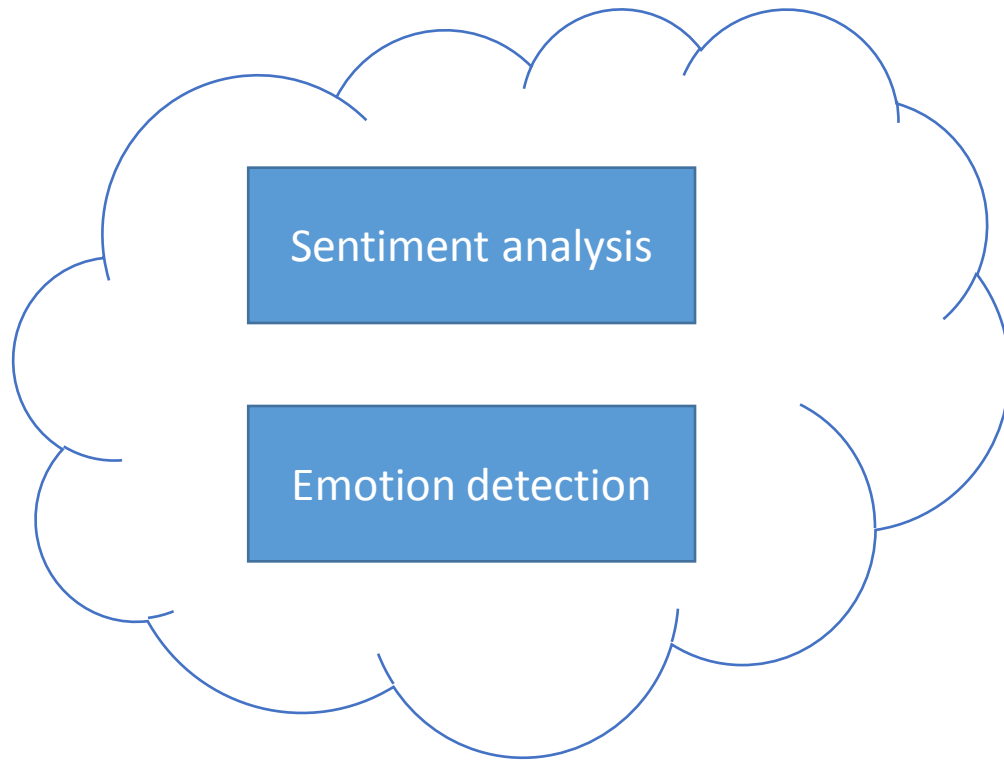


Speech to text



Cloud

Social Networks



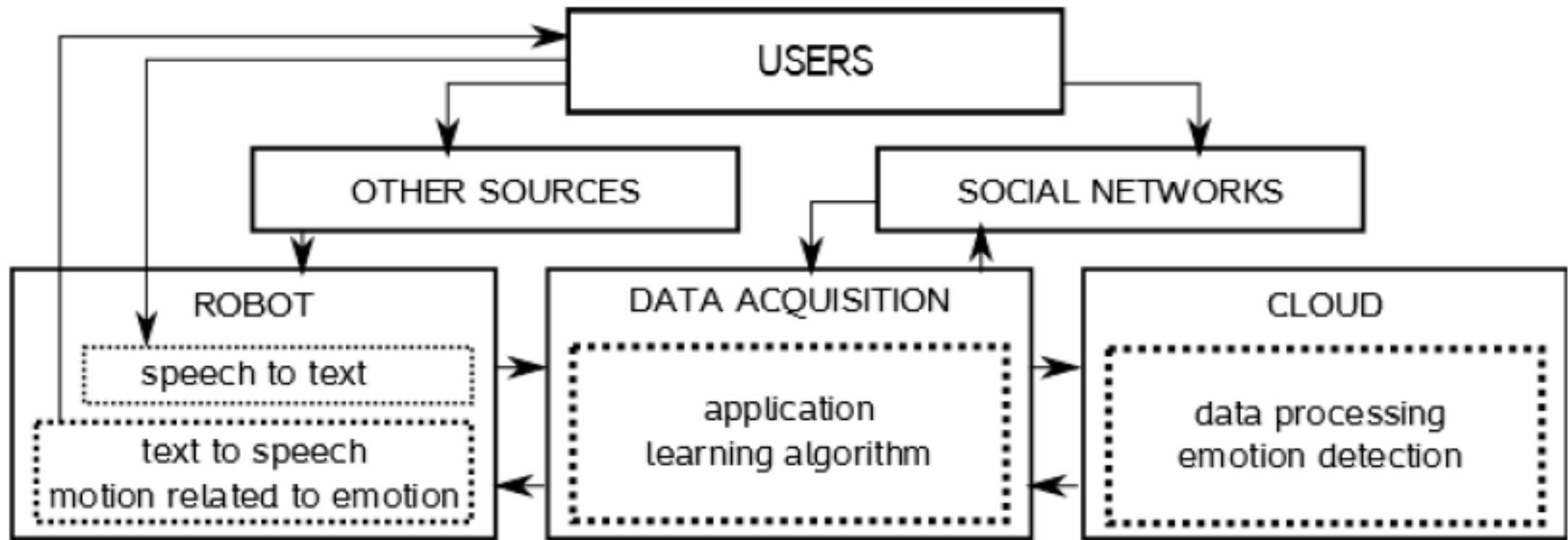


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Speech to text

Gestures







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Technological Goals

1. The design and development of software agent framework ecosystems such as Facebook as interfaces between humans and Facebook
2. The application and testing environment for English text to speech and simple speech to text for NAO robots, including an evaluation environment used as a feedback for developers

Research Goals

1. Proposing a new learning approach for emotion detection in texts
 - will be based on a detailed analysis of corpus based and machine learning methods, resulting in a learning approach more highly accurate and with less human intervention in the learning procedure
 - will take into consideration crowd sourcing to enable a new method for data based enrichment results
2. Propose a new approach to measure improved robot to human interaction
 - the novelty of the measure takes a human centric approach into consideration in the interactions between robot and human

Conclusion

- Exploration in the field of emotion detection is very popular recently
- A lot of research has been done in video and speech processing, but only small progress in the field of text processing
- Implementing the proposed system for detecting emotions into robot will also lead us to solving the specific problem of 'personalization'

Thank *you*!