CHAPTER 7

CONCLUSIONS & FUTURE WORK
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7.1 Conclusions Drawn

This thesis has shown that the representing the dialogue using Bayesian approaches provides an efficient and effective solution for handling the inherent uncertainty and also enable the dialogue history to be taken into consideration when the design of the dialogue manager is to be considered. Various algorithms both for exact as well as for approximate updates for highly complex real-world systems were developed and tested on the sample. The parameters for the belief updating models can be learned on data that is not annotated for dialogue state, which makes the application of such models for new tasks relatively simple. Using machine learning techniques, the system can learn optimal policies and use that for its strategy formulation for a given task. These policies don’t require any human intervention, since all policy decisions are learned automatically. This also simplifies the design process of a dialogue system for new domains.

Experiments have shown that the various approaches presented in this thesis outperform traditional approaches. The proposed framework which includes Semi-Supervised learning of Hidden Vector State model and utilizing prosodic information results in improved handling of uncertainty, improved re-scoring ability of the user model, improved decision making of the policy and finally improved overall performance of the dialogue system. In summary, the approaches described here have several key advantages when compared to alternative approaches. When compared to traditional hand-crafted approaches there are following advantages:

- The system becomes flexible to handle noise.
- The system learns the policies using the reinforcement learning techniques automatically and as such relieves the system designer from additional effort.
- Belief updates are done using possible efficient strategy based on classes and hence happen to computationally efficient.
- Enables building complex spoken dialogue systems.
- More flexibility is allowed e.g. User goal can change during the dialogue process.
- Parameters can be learned without annotations of dialogue state.
7. CONCLUSIONS & FUTURE WORK

Chapter 3 is an exploratory work which identifies current issues in spoken dialogue representation. Thereafter, we propose a framework which aim at mitigating the current issues in dialogue representation and an efficient inferencing. In addition to this, a set of factors are also presented which can help us in choosing appropriate learning technique which aids in automatically policy formulation for the dialogue manager.

Chapter 4 presents how Language Modelling using adaptive hybrid POS cache model can help in confidence scoring for handling errors during the automatic spoken recognition. The model proposed using a window based tri-gram language model which is capable or re utilizing the information for better scoring in future to correct the wrongly identified words by the ASR. The perplexity as well as Word Error Rate had improved over the traditional approaches.

Chapter 5 presents an empirical study of how semi-supervised learning using Hidden Vector State Model can also aid in effective learning. We have used two semi-supervised learning techniques which have made use of both labeled and unlabeled data to improve the performance of the HVS model. The overall performance was improved by nearly 4-5%.

Chapter 6 presents an empirical study to show that prosodic information can be used to identify the intention as well as the mental structure which is normally not given by the words that the speaker speaks and is used in human to human conversations for responding. The results show that it can be determined that whether the speaker is certain, uncertain or neutral about a subject based on the evaluation of prosodic information, like frequency, pitch or intensity etc.

7.2 Future Work

There are some limitations in the present research that stem from the particular research focus and scope that have been chosen. With so many modelling techniques and the very inadequate quantitative and qualitative knowledge about them, we strongly believe that there is a need of much more research and evidence in the spoken dialogue systems. The work in this thesis can be extended or replicated further to produce more realistic, generalized and implementable results.

The work in the thesis can be extended in the following ways:
1. The system design has to have the knowledge of the domain for which the spoken dialogue system is to be designed and has to embed the knowledge using ontologies about the concepts. Future work will need this to be done automatically by discovering the structure of the problem using machine learning.

2. To evaluate the policy learning it has to be tested with a dialogue simulator. Current simulation techniques require large amounts of development time, which makes changing the domain of a system difficult. Future work will develop methods for automatic learning of the system’s user model which could then be extended to user simulation and also evaluate the simulation.

3. To use the non-verbal cues like gestures for framing the dialogue strategy in addition to prosodic information and use kernel methods for this process

4. Refining the proposed framework, if required.