Chapter 1

From Chatbots to Dialog Systems

Tina Klüwer
DFKI GmbH, Germany

ABSTRACT

This chapter provides an overview of the technologies used for chatbots on the one hand and research dialog systems on the other hand. By comparing the two, the main disadvantage of chatbots is shown: its dependency on huge amounts of inflexible language data. Methods originating from Computational Linguistics, which are frequently used in dialog systems, can provide a solution by offering further flexibility to the language processing part of the system.

INTRODUCTION

A common application field for conversational agents is web-based customer support, such as agents integrated into websites. These agents should provide additional ways to control and access information and functionality available beyond the traditionally offered interfaces. By giving the user the chance to interact with a machine via natural language, the provider also gives the user the possibility to come up with less restricted input. Therefore one of the most important requirements conversational agents in industrial applications have to meet is robustness in the face of unexpected input. Another one is an easy way to generate new language content; a task which presumably most of the time does not lie in the responsibility of linguists and therefore needs to be straightforward for content authors not experienced in linguistics. Because of these two demands, the dialog functionality of conversational agents is often based on pattern and/or keyword matching. This technique, which first gained popularity through Joseph Weizenbaum’s chatbot “ELIZA” of the 1960s, fulfills the need of being easy to develop and assuring the understanding of at least a single part (e.g. simple keywords) of the user’s input.

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Unfortunately, these techniques do not only carry the advantages of the idea, but also a lot of problems regarding the understanding of the user’s utterance as well as a great dependency on huge amounts of pattern data. These disadvantages result in inflexible systems.

To overcome these problems several optimizations are possible, from which the integration of knowledge and methods originating from Linguistics and Computational Linguistics (CL) is especially useful. In this chapter, various techniques of Computational Linguistics used in research dialog systems are introduced and the advantage of a possible deployment in chatbot-like architectures is shown. The chapter presents how these technologies can preserve the robustness of a system and at the same time enhance the flexibility.

Firstly, a general overview of chatbot-like systems including their main benefits and disadvantages is given and the main differences between those and dialog systems developed in linguistic research are demonstrated. Afterwards a deeper insight into traditional chatbot systems is given using the chatbots “ELIZA” and “ALICE” as examples. Analogously, the chapter will supply a more detailed look into the work flow and architecture of dialog systems including their linguistic technologies, such as Part-of-Speech Tagging, Named Entity Recognition and Parsing, and shows some concrete examples of an integrated scenario giving an impression of how the different technologies can interact with and benefit from each other. Finally, the benefits and challenges with regard to an integrated architecture are summarized and discussed.

COMPARISON OF CHATBOTS AND THEORY-BASED DIALOG SYSTEMS

There are several definitions of dialog systems and chatbots in the literature and parts of these definitions are similar or equal. This section presents a definition of “chatbots” and “dialog systems” as they are used in this chapter and describes how they differ. A detailed description of chatbots, dialog systems and their methods follows in the next two sections.

The terminology “chatterbot”, also “chatbot”, originates from the corresponding system CHATTERBOT, invented as a game character for a multiuser dungeon game (Mauldin, 1994). Its main task was to answer user questions regarding navigation through the dungeon, other gamers, and objects available in the game world. The system simulated conversational abilities via simple rules and some innovative tricks and successfully “fooled” the other players into thinking it was another user. They were unaware of the possibility of a bot in the game and hence were very cooperative.

In this respect it replicates the success of its ancestor ELIZA, a program developed by the information scientist Joseph Weizenbaum (Weizenbaum, 1966). ELIZA is a small system which gained popularity by simulating a psychotherapist users can interact with via typed natural language conversation. Although Weizenbaum did not call his software a “chatbot”, the chatbot genealogy indicated by this type of conversational system is generally assumed to start with ELIZA, and CHATTERBOT was developed directly based on the experience with the ELIZA program.

Both systems show the main characteristics of traditional chatbots as they are understood in this chapter: text-based interfaces and a stimulus-response pattern-matching algorithm constituting the basis for dialog functionality.

The stimulus-response algorithm is the core of the chatbot architecture. It determines the reaction to a user input via a database containing a fixed set of pattern-template pairs. The pattern can be seen as a surface string optionally enriched with regular expression syntax (in many systems this actually is the case) which can be matched to the user input. If an input was successfully matched against an existing pattern, the hard linked tem-
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