

An Embodied Conversational Agent for Intelligent Web Interaction on Pandemic Crisis Communication

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Abstract

In times of crisis, an effective communication mechanism is paramount in providing accurate and timely information to the community. In this paper we study the use of an intelligent embodied conversational agent (ECA) as the front end interface with the public for a Crisis Communication Network Portal (CCNet). The proposed system, CCNet, is an integration of the intelligent conversation agent, AINI, and an Automated Knowledge Extraction Agent (AKEA). AKEA retrieves first hand information from relevant sources such as government departments and news channels. In this paper, we compare the interaction of AINI against two popular search engines, two question answering systems and two conversational systems.

1. Introduction

The outbreak of diseases, virus, natural disasters and terrorists attacks have caused much miseries, fear and confusion around the world. Examples of such crisis are the Severe Acute Respiratory Syndrome (SARS), bird flu, September 11, earthquakes and the recent tsunamis. In times of crisis, a lot of people will be looking for information. This ranges from management and decision-makers, frontline special or emergency services personnel who have to deal with the situation, citizens who are directly or indirectly involved, and the general public who would like to be informed of the situation and the development.

Due to the rapid advancement of network technology, availability of broadband services, mobile computing and convergence of voice communication and public broadcast into an internet based system, it is therefore foreseeable that the Internet will become the dominant communication system in the world. It is anticipated to overtake the traditional means of telecommunication such as voice networks and the public free-to-air broadcast. Hence, a global crisis communication system based on the internet has been proposed in this paper. One of the key components of the proposal is a computer-driven, natural language “chatterbots”, capable of providing meaningful and quick responses to queries from the users in a conversational format. The prototype system is compared to two popular search engines – Google and

Yahoo!, two question answering systems – START and AskJeeves and two conversational systems – ELIZA and ALICE. With more natural and meaningful responses, it is expected that the proposed ECA will provide assistance to her users during real-world crisis situations.

2. AINI's Conversational Agent

This research project involves the establishment of a Crisis Communication Network (CCNet) portal. The objective is to use an embodied conversational agent (ECA) based on an architecture called Artificial Intelligent Neural-network Identity (AINI) [1]. The real-time prototype relies on distributed agent architecture designed specifically for the Web. The software agent is based on a conversation engine using a multi-domain knowledge model and with multimodal human-computer communication interface. It also offers multilevel natural language query which communicates with one another via TCP/IP. AINI or AINI is a conversation agent (or chatterbot) which is capable to engage the user with a meaningful conversation on specific topic. In this particular application, the topic is on the possible pandemic virus, H5N1. From another perspective, AINI can be considered as a software conversation robot. It uses a form of human-computer communication system which is a combination of natural language processing and multimodal communication. A human user can communicate with the developed system using typed natural language conversation. The embodied conversation agent system will reply in text-prompts or Text-to-Speech Synthesis together with appropriate facial-expressions. Given a question, AINI first performs question analysis by extracting pertinent information to be used in query formulation, such as Noun Phrases and Verb Phrases. It also employs an Internet three-tier, thin-client architecture that may be configured to work with any web application. It comprises of a data server, application and client layers. This Internet specific architecture offers a flexible solution to the unique implementation requirements of the AINI system.

3. Natural Language Query for the H5N1 Conversational Agent System

In this paper, Bird Flu pandemic is the Domain-Specific research focus. Research and information on H5N1 pandemic have become increasingly important as the pandemic will have dire global implications. Wall Street Journal Online [2] predicted that this pandemic could be worse than the one in 1918 which killed at least 20 million people. In addition, the World Health Organization estimates the H5N1 virus could infect up to 30 percent of the world's population. Shigeru Omi, a WHO official, also warned that an estimation of 2 to 7 million deaths are "conservative" and that the maximum figure could be as high as 50 million [3].

The AINI domain knowledge model incorporates several knowledge domains. This is analogous to the consultation of expertise knowledge from multiple experts. For example, a *sales* domain knowledge should contain expertise or knowledge on how to improve sales. However, the system should also incorporate Open-Domain knowledge to handle general or generic questions. By including multiple domain knowledge bases with AINI's single domain knowledge, the ECA will be able to hold meaningful conversations with the users. In this proposed system, the Open-Domain and Domain-Specific knowledge are pre-defined in the Data Layer. Depending on the user's input, the agent will respond or switch from one domain knowledge base and natural language query Level to another knowledge base. While the system is capable to communicate with the user beyond the domain knowledge, the conversational agent will continue to remind the user by bring the focus back to the current topic of interest. This is to direct the users' attention back to the system's Open-Domain or Domain-Specific state. However, the priority will always be Domain-Specific.

4. Experimental Setup to compare AINI ECA with other systems

In this experiment, three types of proprietary systems are compared. They are *search engine*, *question answering system* and *conversational system* (or, chatterbot). For each system, we compared two difference engines against AINI ECA. The two search engines compared are Google and Yahoo! due to their popularity. For the question answering engines, AskJeeves and START are supposed to use natural

language processing for their queries. For the conversational engines, the well known chatterbots ELIZA and ALICE are selected. In particular, ALICE was ranked as the "most human computer" in the Turing Test competition [4].

Google is a well known search engine which determines relevancy of information primarily on their PageRank algorithm. In our experiment, we developed a search engine interface using Google SOAP Search API service [5] and Yahoo! [6] which enable us to query the vast amount of web pages directly from the CCNet portal. For the Question Answering system, the original idea behind Ask Jeeves and START was to allow users to get answers for questions posed in natural language. ASK Jeeves is the first commercially question answering system available on the Internet. START [7] is the world's first Web-based question answering system which commenced operation since December, 1993. ELIZA is a well known program in the discipline of Artificial Intelligence. Created in the early 1960's by MIT scientist Joseph Weizenbaum [8], ELIZA is also the oldest system of similar type. ALICE[9] is a general conversation chatterbot based on the Annotated ALICE Artificial Intelligence Markup Language (AAA). The knowledge base rule set consists of approximately 46,424 categories. In a way, AINI is an enhancement of ALICE with the inclusion of the Pandemic Domain-specific knowledge base which was extracted using AKEA, and parsing capabilities based on a full Natural Language Understanding engine for multilevel natural language query. In the present study, appropriate or accurate domain responses are expected to be important. The control question set was submitted to the seven URLs where the seven systems were located. The responses of the queries are then collected and displayed as

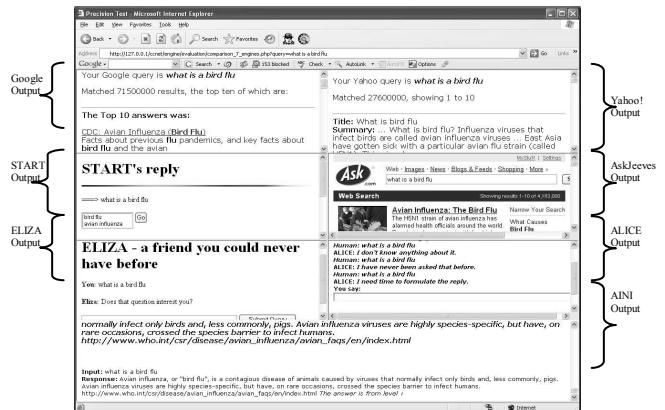


Fig. 1 Experimental Design Interface shown in Fig. 1.