RE-phrase: Chat-By-Click

A Fundamental New Mode of Human Communication over the Internet

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Abstract

There is a fast growing need for companies to handle full text interaction via internet with chat-like functionality, think of online helpdesk, demand aggregation, etc. However, even state-of-the-art language technology is not able to automatically handle consumer requests in a reliable and sensible manner. Semantic text understanding systems are brittle and expensive to maintain, and simple pattern matching text-bots cannot handle the complexity of natural language and often give useless or wrong answers. RE-phrase meets this need by starting from threads of real human textual interaction (chat, helpdesk) and then storing and re-cycling it for fast multiple-choice conversation with automated replies. It is a new technology for users to interact via the Internet, which combines browsing and chatting. It makes use of an adaptive and collaboratively growing database of conversation phrases. It is fast, adaptive, allows full text entry, and is well suited for different types of browsers and platforms.

Keywords

Full text processing, conversation, dialog systems, helpdesk, frequently asked questions, web service, chat, communication.

ACM Classification Keywords

H.5.4 [Information Interfaces and Presentation (e.g., HCI)]: Hypertext/Hypermedia---architecture,

navigation,user issues; H.5.2 [Information Interfaces and Presentation (e.g., HCI)]: User Interfaces---graphical user interfaces, natural language; H.4.3 [Information Systems Applications]: Communications Applications; H.3.5 [Information Storage and Retrieval]: Online Information Services---web-based services.

Introduction

Conversations often follow standard patterns. RE-phrase exploits this by storing dialogs incrementally, enabling users to select previously typed utterances rather than re-typing them. Communication partners then traverse a conversation graph by taking turns in selecting the next statement. Statistical usage information is applied for ordering and filtering the alternatives that are presented on each choice point. If needed, a (series of) new statement(s) can be entered (creating new graph nodes). Edges between existing nodes in the graph can be added by matching entered text to stored phrases. If a user deems a found match to be correct, a new connection is made. Thus, the network grows larger and denser, but is pruned as well, in an organic fashion.

A RE-phrase conversation forms an alternative for a Frequently Asked Questions list. A site visitor can question a virtual employee until a human operator steps in to provide an answer to a question that was not yet part of the stored conversation. This smooth transition provides a graceful fallback scenario, enabling organizations to present themselves in an interactive way to their customers without the full costs of the one-to-one support of a call center. Offline responses via e-mail are also supported.

Utterances can be stored in many languages and the appropriate one retrieved for each user. Thus, another application is translation and language guides, e.g. using medical conversations prepared by patients' interest groups abroad. Think of ordering in a foreign restaurant, etc. Many conversation topics are location based, making RE-phrase ideal for use on mobile devices with GPS. RE-phrase conversations can be transformed without information loss to a functional VoiceXML application, providing yet another channel, for situations where no keyboard is at hand (such as in a taxi).

Architecture

RE-phrase is an internet service, accessible from a variety of platforms and web browsers. The system is supported on mobile devices as well as (desktop) computers.

Choices
A number of design decisions underlie RE-phrase:

- Thin clients. Wishing to support a large number of devices and browsers, and taking into consideration the large variation in processing power on these endpoints, RE-phrase is a server-oriented program.

- XML. Conversations are represented as networks of phrases. Foreseeing a need to annotate phrases with a large variety of types of information, an easily extensible representation was needed, making XML a logical choice. Moreover, as the external presentation of internal objects is expressed as HTML, rapid transformation of these objects to HTML is of paramount importance.
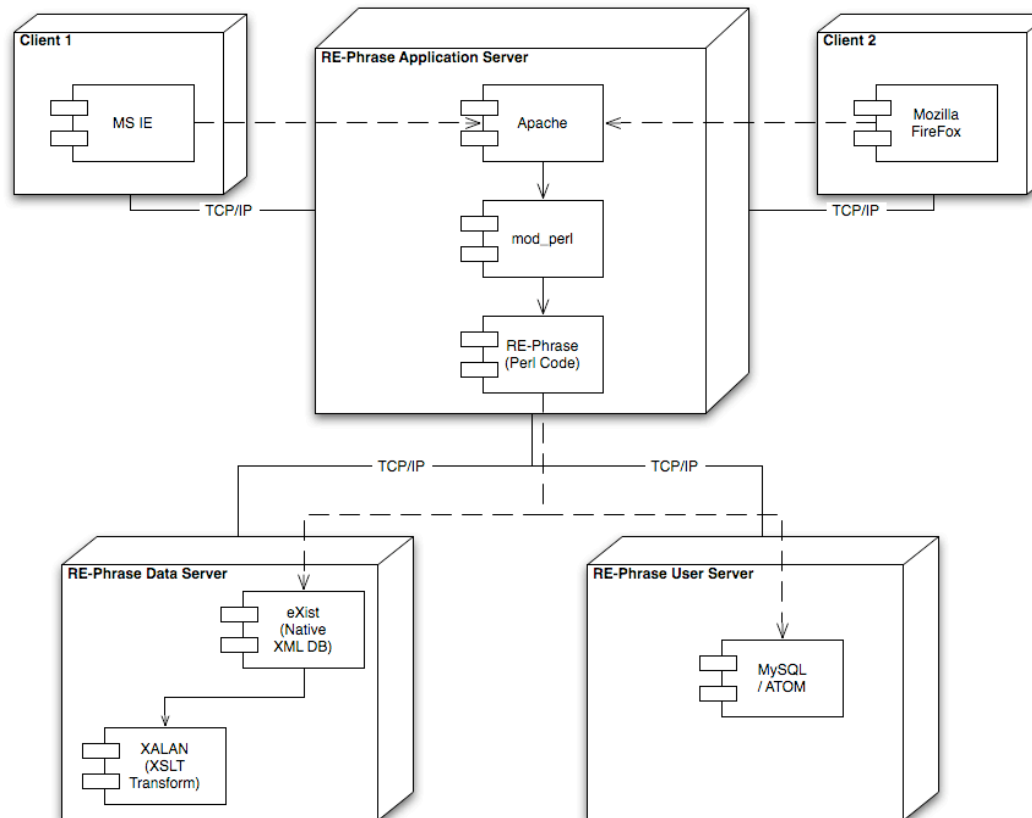
figure 1: Deployment diagram

▪ Standard adherence. Everywhere we chose for open W3C standards [5], like HTML, XML, AJAX, etc. Wishing to create a modular program that can be added easily to social computing websites or corporate websites, we have embraced the emerging OpenSocial standard for accessing information about people and their relationships.

▪ SOAP or REST-style APIs. Though the sources of the central RE-phrase services are not publicly available, we invite third parties to use these services and augment them. This is facilitated by publishing the services and making the functionality available through the SOAP protocol and through a REST-style protocol.

Design

Figure 1 gives the deployment options for a RE-phrase program. Note that, even though the server side is shown as deployed on three different computational nodes, it is entirely possible to run the complete system on a single physical server. Note as well that some components can be easily replaced by functionally equivalent ones (e.g., Saxon for Xalan). Figure 2 illustrates the object oriented nature of the server program. The entire communication process is modeled on the server. The presentation to human actors is derived from this internal process, mirroring the internal state in terms of an easily comprehensible (graphical) user interface.

figure 2: Partial sequence diagram showing interaction between computational objects representing natural users.

Event Model

The basic unit of communication is the phrase, a single utterance by one of the participants. The life cycle of a phrase through the server process is marked by a number of events. These events can be used by application programmers to attach custom handlers, in order to provide new functionality not provided by the core system. As an example, a conversation for a mobile device using short range communication (e.g. Bluetooth) needs a way to establish a list of devices in range. A custom handler would access a (client side) API to find devices in range and produce a series of answer options based on that list. Other examples of dynamically computed contents are weather forecasts, current time, currency calculation, etc.

Implementation

RE-phrase is built on a collection of strong components. XML is handled almost exclusively in the open source eXist XML native database, using stored XQuery procedures. XML to HTML transformations are handled by Xalan, the open source XSLT processor from Apache. The program is served from the Apache HTTP server (however, care has been taken to ensure that the same program can be served from Internet Information Server from Microsoft). The server code itself is written in Perl (for version 5.8.8). The code is interpreted using Apache's Mod_Perl (version 2.0), providing fast responses through cached compilation.

User Interface, Mode of Interaction

Figure 3 shows an interaction using the translation application (named "KlikTolk" here, for a Dutch audience). A Japanese client orders her menu to the English-speaking waiter, using a mobile device.
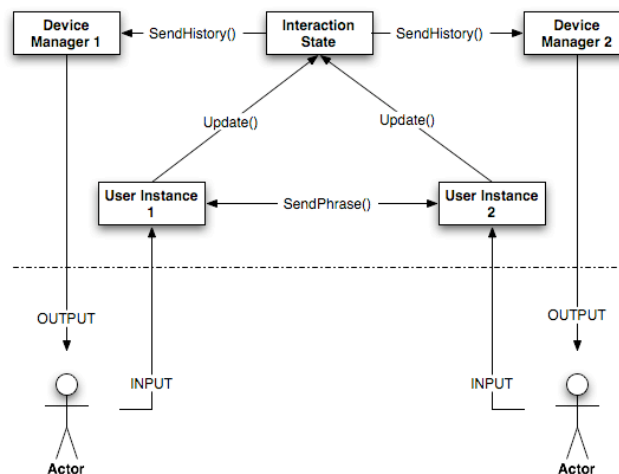
figure 3: Top: the English waiter replies to a question by his Japanese client (shown here in English!). Bottom-left: the Japanese client receives the suggestion (in Japanese). Bottom-right: the waiter receives the answer (in English).

Comparison to other modes of communication

People have been communicating through a large variety of devices. Each of these channels is a reduction of a full, face to face conversation [3]. For example, the telephone offers just voice, an (e)mail exchange omits even that, falling back on written text. However, people do not just experience a loss of bandwidth: telephone

often invites greater confidentiality and a letter permits the writer to communicate with greater precision and care. Indeed, this observation can be extended to newer communication channels: instant messaging (IM) seems to inspire a new compact form of written language (4u & me) and intriguing typographical conventions to convey emotion that goes far beyond ordinary punctuation (emoticons). It has also been observed that people express themselves much more vehemently in virtual public areas (newsgroups, weblogs) than in a physical environment. Also, some aspects of communication are supported well by graphical languages, while others are best expressed in a dialog style [2].

A communication mediated by RE-phrase provides yet another way to lose bandwidth and might, extrapolating from the above, give rise to a new communication experience. The speed and way of interaction is similar to instant messaging. However, the sentences used are composed with much more care than is usual in IM. The style and language is more like that used in a letter. But most important is that RE-phrase conversations must be useful for many people: indeed, the very way these conversation databases are constructed all but guarantees that they are. Thus, a RE-phrase conversation cannot be personal in a strict sense: each participant can only communicate from a specific role.

People interacting with a RE-phrase helpdesk application report to experience a 'real' conversation, even though they are fully aware that they are using a computer program and do not communicate with a natural person in a synchronous fashion. This sets RE-phrase apart from reading a Frequently Asked Questions list (FAQ).

Future Work

People with communication challenges
Healthy people are not the only ones that can benefit from the RE-phrase technology. People with autism can benefit from RE-phrase as the conversation is very predictable and structured, and less threatening than real-life interaction. The low bandwidth also makes it an ideal communication tool for people with severe physical impairments. Many people with motor impairments are only able to operate a switch, for instance by tapping their foot or blinking their eyes. Currently there is a number of techniques that help impaired people produce letters or words[1]. To be able to select whole sentences instead of individual letters or words, will greatly increase the speed of communication for these individuals. Communication with a caregiver can be greatly sped up. RE-phrase could, for instance, be connected to the switch operated by the patient. In this way the patient can select the sentence to be communicated, and in turn, the caregiver can select from a set of possible answers. Conversation in this domain is rather restricted and can therefore be rather easily captured in a RE-phrase database.

BCI
For a small group of people, even a switch will be uncontrollable. For instance, patients with Amyotrophic Lateral Sclerosis (ALS) suffer from a degeneration of nerves from the motor cortex to the muscles. In the final stadia of the disease, patients are completely paralyzed, but still aware of their surroundings. This is also referred to as the 'locked in' state. For these patients, a relatively new technology is being developed: Brain Computer Interfaces [4, 6]. A Brain Computer Interface (BCI), tries to map measurements of brain activity to computer commands. Currently, the bandwidth that can be gained is relatively low. Therefore, using RE-phrase on the output side of a BCI would be advantageous if one is developing a BCI for communication purposes.

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