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Abstract

In this paper we consider e-mail as a task management tool. We present and discuss the results of an explorative study of task management in a user's daily electronic life. Our general goal is to restructure the domain of Internet e-mail. The purpose is to make it even more suitable for cooperative, message-based communication in both virtual and real organizations. Specifically, we aim to design a control mechanism to support the identification and delegation of tasks and dissemination of information to users in an organization employing e-mail. The users are characterized by high mail traffic and a need to manage e-mail in different organizational roles. A tentative solution and a prototype are briefly described, using a previously developed conceptual model of information management in e-mail as a starting point.

Introduction

Electronic messages in the form of e-mail proliferate daily life in organizations today. The diversity of e-mail use is large (Mackay 1988; Takkinen 1994). People use the e-mail client as a time management tool, a task management tool, and (or) an information management tool (Mackay 1988). A helpdesk operator for a computer hall at a student campus, e.g., handles a large variety of e-mail messages, ranging from queries about accounts and available software to queries about policies and individuals of the organization. Furthermore, people in organizations have different roles that affect their work situation and their use of different information sources for filtering and managing messages and tasks. Some examples of roles are: teacher, supervisor, researcher, and system administrator.

The e-mail interface is still a too thin a layer on top of a delivery system. We aim to design a model and develop a prototype for use in e-mail that supports the user in her management of tasks in e-mail in her different roles. By modelling different tasks we are restructuring the application domain of Internet e-mail (e-mail using SMTP and POP3/IMAP protocols) and making it more usable for collaborative work in an organization. Of central interest to our work is to keep the open architecture of Internet e-mail. This paper is organized as follows. A brief background and related work to task-oriented treatment and filtering of e-mail are given. An explorative study and its results are presented. A tentative framework that refines and extend our current conceptual model (and prototype) for information management in e-mail is described. We end the paper with a description of the work lying ahead.

Background

A task-oriented restructuring of the application domain of e-mail was initiated by Fleming and Kilgour (1994). A number of general tasks that users perform using e-mail were identified, such as problem solving, negotiation, discussion, and request for and dissemination of information. Different types of messages were also identified. By reinforcing and suppressing certain characteristics of certain messages, the presentation on the screen was made more readable.

The basic functionality to manage tasks includes filtering (classification and prioritization) of messages. A survey made of Internet e-mail clients (Takkinen & Shahmehri 1998) revealed that filtering based on keywords in message headers for handling incoming messages is common, as is the use of folders for storing messages, and two-paned or three-paned display of messages. An example of a commercially available, corporate-based e-mail system that incorporates the concept of tasks into e-mail in a very basic way is MEMO (Verimation 1998). A "workflow item" arrives in the MEMO mailbox just like ordinary mail items, forms and calendar invitations. MEMO has calendar and scheduling functions, as well as forms (Malone et al. 1987). However, to manage the tasks conventions must be followed by all workgroup members. An innovative, more dynamic and personalized message filter is represented by CLUES (Marx & Schmandt 1996). Although it does not use the concept of tasks, it however infers message timeliness by considering information available in a user's electronic environment, such as calendar appointments, outgoing messages and phone calls, and by correlating these data via a personal rolodex.

The common goal of the systems above is to achieve a more "intelligent" or structured filtering or organization of the information, on a level conceptually higher than simple keywords. Some of the challenges are to keep track of a user's interests,

to formalize tasks (Mazer 1988), and to effectively combine synchronous communication with e-mail (Sakamoto & Kuwana 1993).

An Explorative Study

We designed the explorative study with the purpose to investigate what kind of actions (different functions and commands) and tasks a subject performs in certain roles. We adopted a user-centered approach based on a modified model of methods by Bryce (1996). Both interviews and questionnaires were employed. During interviews, the subjects were asked to refer to actual messages and exchanges of messages in their e-mail.

The questionnaires were distributed by e-mail to mailing lists within two computer-related departments at the university, to two student choirs, and to a group of alumni computer science students. A total of 159 questionnaires were returned, which we grouped into four categories: doctoral students (55 in all), other academic people working at the university (55), industry people working outside the university (32), and undergraduate students (17). The groups are henceforth coded DS, AP, IP, and US, respectively. The questionnaires were used primarily to collect data about the scale and patterns of usage of functions such as forwarding, filtering, templates, aliases, and the address book. We concentrated on (current and future) scenarios where tasks were delegated and information was disseminated. Furthermore, four subjects from the university of the authors were interviewed: a helpdesk operator, a doctoral student, a director of a research group, and an administrator. Some of the results of the study were (Takkinen 1998):

- advanced formatting of messages by using extra bold type, HTML, etc. is rarely done because it takes time and because the messages are mostly short, and also because the receiving side cannot be presupposed to see the same layout; instead, documents are created in a word processor and attached to the message
- templates (other than signature files) are not widely employed because they are a hindrance and because most messages are short
- forwarding messages is very popular: a new message is created via a forward button, the recipient(s) and a subject line are added to the header, and some explanatory text is put in the body of the message; it is also notable that the forwarded messages tend to be of less importance to the subject who is doing the forwarding
- confirming the delivery of messages is generally cumbersome with Internet e-mail and typically the telephone is used to confirm important messages; some subjects even used ICQ (1998) or the Unix command finger to verify message deliveries
- accessing one's e-mail is often done from different computers using different e-mail clients, and being in different roles depending on the place where the e-mail is accessed from.

Furthermore, aliases and the address book are used heavily. The DS and the IP tended to read e-mail as it arrives, while other AP read mail in intervals. Generally, e-mail is regarded as extremely useful, especially by the AP. Filtering is used mostly by the DS (41 %) and the IP (38 %) in the study. The AP had the largest spread of the number of mailing lists, 1–50, while the other groups had a more modest spread of 1–22 (DS) and 1–15 (US and IP). The US were most unsure (24 %) about the number of mailing lists they were subscribed to, as compared to the other groups (7–15%).

Refining Our Conceptual Model

Traditional rule-based mail filtering systems are difficult to configure (Takkinen 1994) and the rules do no change to reflect daily or weekly activity, i.e., the short-term interests of the user (Marx & Schmandt 1996). Furthermore, the mobility of users indicates that different rules are needed for different electronic environments and roles.

A task can be defined as an exchange of more or less naturally chained messages. Small tasks can be contained within a thread of messages (usually with the same subject). Certain types of messages dominate certain tasks. For example, the action memo, or a Policy message (Crowston, Malone, & Lin 1988), is typically used for delegating tasks within a project (Fleming & Kilgour 1994). Hence, threads and message types can be employed to keep track of tasks. Confirming the finishing of a task must consider the possibility of the user employing synchronous communication, i.e., there has to be some way for the user to explicitly mark a task as completed. This function is something similar to the kill files used in netnews.

We have developed CAFE (a Categorization Assistant For E-mail), a conceptual model for information management in e-mail (Takkinen & Shahmehri 1998). The user can explicitly tell the system her state of mind via three modes (see fig.). The Cool mode (default) contains the traditional filtering of messages, including the user's own folders. The Curious mode is invoked when the user has much time on her hand and she wishes to organize messages from, e.g., a mailing list. The Busy mode is invoked at times of high stress and makes use of a low number of system-defined folders to organize new and unseen messages in priority order. An implementation of CAFE (ibid.) required using a different information retrieval and filtering technique for each mode. This need to use multiple adaption techniques to cope with uncertainties, such as a user's changing interests, has been recognized, among others, by Mostafa and colleagues (1997).

We are now extending CAFE, concentrating on the Busy mode. We are specifically interested in messages that a user puts on a to-do list. A user's short-term interests can be dynamically modelled (and without extra effort from the user) by using the data available in, e.g., the outgoing messages, the address book, the calendar tool, the bookmarks of the web browser, and the database of employees in the organization. Furthermore, the structure or layout of messages has not been much employed for
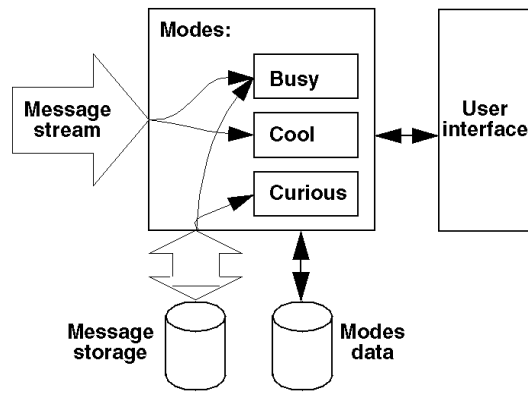
filtering purposes. We hypothetize that the information from these different sources can be used to identify the different types (or even genres) of messages that characterize tasks and projects.

Filtering messages based on tasks make it possible to construct an intuitively understandable, task-centered control mechanism to support the delegation of tasks to individuals in an organization. The meaning of "a control mechanism" is threefold:

- a framework for handling tasks and message types
- algorithms for filtering e-mail
- a prototype using the extended CAFÉ.

Toward a Prototype

The prototype can suggest to the user how a message has been classified and prioritized in relation to a task, and which recipients could be interested in the message. The user can tell the system to keep track of a task. Tasks need not be predefined but are defined incrementally and characterized by message types.

We are examining machine learning algorithms (Cohen 1996; Mitchell 1997) and combining them with domain knowledge. Learning techniques can support the high degree of adaptivity required while minimizing user intervention. We are considering to access the meanings and contents of messages by using speech act theory (SAT) (Kimbrough & Moore 1997).

Our final goal includes a method for restructuring an application domain, a complete framework (with respect to CAFE) for managing message-based tasks, and an agent-based (Bradshaw 1997) prototype implementing our ideas.

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