

# Toward Opportunistic Communication Systems

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## ABSTRACT

Many of our conversations are not planned. Instead, they arise opportunistically as we become aware of the common interests and goals of others. We describe a prototype system, I2I, that allows users to collaborate based on their immediate goals and interests. I2I is embedded in common document manipulation applications, where it can notice opportunities for collaboration by clustering the documents users are manipulating based on their content, grouping related documents into a single conceptual space. It then makes the common work contexts of users visible by displaying only those users who are manipulating related documents. I2I provides users with opportunities to communicate synchronously and asynchronously within the context of the activities they are performing in their primary application, without requiring they manually orchestrate the communication themselves. Once users become aware of each other, they can use the system to communicate using a variety of interactive modalities.

## Keywords

opportunistic communication, awareness, matchmaking, context

## INTRODUCTION

Efforts in building collaborative systems have focused on developing techniques to support awareness among group members engaged in a specific task. While tools that support group awareness in the context of inherently collaborative work are becoming more common, less attention has been given to supporting the kind of awareness necessary to give rise to collaboration in the first place—the kind of informal collaboration and communication that commonly occur in physically-located settings organized around common goals. Our focus in this work is to make the kind of opportunities for informal collaboration that are currently available in the physical world available in the electronic realm.

Our approach is to build systems that notice opportunities for collaboration by tracking the work people do in everyday applications. As a result, they can make users aware of common interests and goals, so that people can easily establish connections in order to cooperate and share with each other. Combined with standard collaboration and

communication tools, such a system can transform traditionally solitary activities into collaborative ones by providing users with frictionless access to potential collaborators.

Our prototype system, I2I, is our first attempt to address this challenge. I2I automatically clusters the documents users are manipulating based on their content, grouping related documents into a single conceptual space, allowing users manipulating related documents to collaborate. I2I manages the early stages of initiating informal collaboration by providing its users with opportunities to become aware of the activities of others that share common interests, as represented by the documents they interact with. I2I attempts to build communities of common interest on the fly, allowing users engaged in traditionally solitary activities to discover common goals and collaborate with each other. So, for example, if two I2I users are both writing papers on the same topic, they can become aware of each other and collaborate through the system.

## HOW THE SYSTEM WORKS

I2I integrates with applications using an adapter architecture similar to the one used in the Watson system [1]. Each adapter is responsible for sending the system's central broker a message when the document has changed in an attached application (e.g., the document is edited significantly, or the user opens or navigates to a new one). The broker computes a term vector representing the document in the vector space model with *tfidf* weights [2,3].

Secondary objects can also be associated with a document in the space I2I has built. The simplest of these objects is people: users who are viewing a particular document are associated with that document's point in the space (see Figure 1). Currently, I2I also indexes chat rooms and calling cards (a facility for asynchronous communication) in the same way.

The broker computes a similarity matrix for documents that are currently being manipulated. The similarity values in this matrix determine what a user sees from the vantage point of a particular document. Users can see things close to them in the similarity space. That is, secondary objects associated with documents  $D$  whose similarity is above a threshold  $\theta$  with respect to  $d$ , the current document, are

visible from *d*. The chance of two people reading exactly the same document at the same time may be slim. By grouping conceptually similar documents together, I2I makes it more likely that people will see each other and start a conversation. It also allows unpublished documents to serve as an entry point into the system.

### USER INTERFACE

I2I embeds an interface for displaying information directly into applications, where it is supported (see Figure 1) to allow the user to easily correspond the information I2I displays with the document it is associated with. This allows users to easily keep track of their activity in several conceptual spaces at the same time.

Information is grouped into tabs (see Figure 1 above "Online users") and includes (from left to right):

1. *System activity*. Users can see how many I2I users are online both within and outside of the conceptual space defined by their document.
2. *Who is online*. Users can see the login names of the people reading or writing related documents. Users can also contact each other directly from here.
3. *Related pages*. I2I displays recommendations generated by the Watson system [1].
4. *Active chat information*. I2I displays a list of chat topics created by users in the conceptual space around the current document.
5. *Calling cards*. I2I displays a list of calling cards that other users have left while viewing the current or related documents

### Synchronous Communication

As users become aware of each other, they can communicate synchronously either one-on-one, using instant messaging and videoconferencing, or in groups by creating or joining chat rooms. The point is that once the endpoints of the conversation are known, the system can leverage standard communication tools to mediate the actual conversation.

### Asynchronous Communication

I2I's primary facility for asynchronous communication is calling cards. Users can leave calling cards associated with the content area represented by their document in order to indicate they have something they would like to discuss. Leaving a calling card allows users to explicitly make their goal to communicate visible to other users who also view documents in that topic area. If a user is eager to open a discussion channel with somebody else, but no one is available or has shown interest, the user can leave a calling card to invite people to talk at a later date. Unlike previous systems, which index annotations at the document level, I2I indexes calling cards by a content vector representing the document at which they were created. This means public access to the document at which a card was left is not necessary for other users to see the card when they are

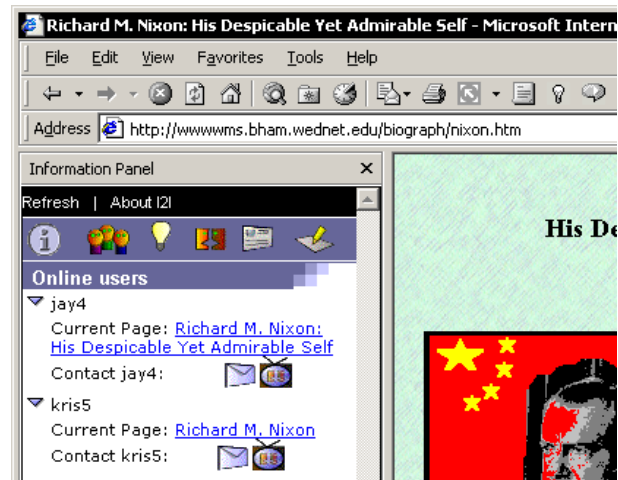


Figure 1. People visible from a page about Nixon include users who are viewing different documents on the same topic.

browsing or writing in related areas. It also means that the content of a Web page can change completely, and the calling card will only appear in contexts similar to the one in which it was created. As a result, this kind of indexing ensures the system maintains appropriate referential relationships between the content users contribute and the contexts in which they are appropriate.

### CONCLUSION

Although there are a wide variety of tools that support communication over the network, they tend not to support the kind of opportunistic communication that arises out of an awareness of common goals and interests. I2I attempts to address this issue by embedding communication facilities in the user's everyday applications so that users that share interests can be aware of each other and communicate freely in an informal environment, even though they may have never met nor discussed the interests they share.

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