

A Taxonomy of Internet Communication Tools

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Abstract

When looking at the social phenomenon that arise from the use of Internet communications tools, one must consider the properties of the tool that influence human-to-human interaction. This paper presents a number of such properties and discusses their importance. In addition, existing Internet communications tools are described both in general and with respect to the properties.

Introduction

The term 'virtual community' has been used to describe all manner of computer-supported communication. In some cases the sum total of all such communications is termed the virtual community, but in most cases the term is limited to communication that makes use of a single network resource. But the ability to communicate in and of itself does not ensure that a community will form. Indeed most attempts to define exactly what a virtual community is require an in depth look at what is required for a connection to become a community. Often such definitions are presented as a collection of anecdotes that attest to the social diversity necessary for 'community' [11, 15].

Virtual communities that are in existence today are supported by a wide variety of communications tools. The various properties of these tools exert a strong influence on the character and structure of the communities they support. An examination of these tools can be cast in terms of the

properties that most shape the communities built on the tools.

This paper both distinguishes properties which have a significant bearing on social interaction and describes the various categories of tools for communication on the Internet.

Properties

Conversational Synchronization

An important distinction between these tools is the synchronization between the composition of a message and its receipt. The Internet was designed to support store-and-forward, or asynchronous methods of communication. In this type of communication, any one message is received at some interval after it has been composed, usually when it is explicitly requested. In most such systems, particularly email and news, this results in the receiver of a message perceiving that the sender is more intelligent or eloquent than would otherwise be the case. This perception arises out of the increased amount of time that can be spent composing an effective message.

Real-time, or synchronous, communication, on the other hand, does not allow for extended delays in message composition. Applications such as Internet Relay Chat, video conferencing and Internet telephony require that participants respond in turn to their conversational partners' utterances. This leads to an experience similar to face-to-face conversation, rather than the store-and-forward exchange of letters.

Some real-time methods use text as the medium of communication, which allows one to trace the history of a conversation with some accuracy, while others use audio and video, where the specifics of conversation are ephemeral, and must be recalled by participants.

Conversational Style

Another property of computer-mediated communication is the conversational style that each method supports. Email and Talk support a person-to-person style of conversation, where both conversants are equal partners in the exchange.

On the opposite end of the scale are the web, Internet radio, and FTP, which are broadcast media. The composer of the message sends it out to many people, most of whom are unable to respond in the same medium, and those that can are generally unable to directly target the original sender.

As a median between these there are forum style methods of communication. Examples of such a style are newsgroups, electronic mail lists and a large number of real-time conversation ('chat') systems, including Internet Relay Chat, WOOs, web chats, Virtual Places, virtual environments, PowWow, and the various forms of multi-user environments (MUDs, MOOs, MUSHes, MUSEs, etc.) often known collectively as MU*s. Forums allow for conversation among groups of people, with each person being able to respond to each other participant.

Communications Media

Another distinguishing feature of communications applications is the conversational media they support. Most systems support text, the original media of Internet communication, though some (Internet radio and Internet phone) support only audio. A growing proportion of Internet traffic includes static graphic images, as supported by the web, and chat systems implemented on the web (WOOs and web chats) generally also support limited graphics - generally pictures of the conversants. A limited number of applications support a representation of each participant in the conversation. These 'avatars' [12] allow for the positioning of a participant within the setting of the conversation (Virtual Places) and can also represent the person's facing (most virtual environments, including WorldsChat).

Some media, audio and video in particular, are highly ephemeral. Communication requires active attention or conversational flow is lost. Most other media, however, leave a short term trace of recent utterances and therefore can support a more detached conversational participation.

Initiation Method

The different tools support a number of ways in which conversational partners locate one-another. For some tools, like newsgroups, which propagate messages through replication, no effort is required on the part of the user; the messages are simply available, and they merely need to add their own contribution (the actual mechanics of which local machine holds

the message bases complicates the issue slightly, but can be ignored by the end user). Email on the other hand, requires that the writer of a message know the user name and machine name of their readers Email account, which is known as their Email address.

Many of the real-time tools (Internet radio, video conferencing, Internet phone, etc.) require that the connection be made to the machine that the other conversant is using, through the machine's address. Others require connection by all participants to a single server, also based on address. In such a case, all communication is routed through the server machine.

For some tools (Virtual Places, web news) the space of conversation is defined by a particular World Wide Web page, located either by browsing through the web or by using a specific URL.

Locating other conversant through a server, a URL or replication doesn't require that a participant previously know the others they communicate with. Mutual knowledge of the location of a communication resource is all that is required to be a member of the community.

Audience Membership

Some applications require that participants be members of a certain online system, rather than being part of the global membership of Internet users. On such constrained membership systems, one can only communicate with other members. BBS's, in fact, allow for the use of Email, newsgroups, and chat systems resembling both IRC and Talk among a constrained rather than the global membership supported by the individual tools.

Having a constrained membership leads to more personal accountability for an individual. Disruptive acts are more easily tied to an individual, and such acts can put an individual's group membership in jeopardy.

Dialog History

For many of these tools no history of the conversation which has taken place up to the current point in time is available. Without a history of communication, a new participant in the conversation is unable to acquaint themselves with the conversational style of the other participants and the

recent course of discussion. While for some tools this is not a problem, either because they are person-to-person, based on real-world conversational protocols, or they have no salient course of discussion, for others it can be problematic.

When there is not dialog history, the arrival of a new participant is often marked by a period of introduction where the newcomer attempts to get up to speed. This requires a fair deal of social initiative however, and many newcomers must 'lurk' for a time before feeling sufficiently grounded to participate.

| Tool | Synchronization | Style | Audience Membership | Communications Media | Dialog History | Initiation Method |
|-------------------------|-------------------|------------------|---------------------|------------------------------|----------------|-------------------|
| Email | Store-and-forward | Person-to-Person | Global | Text | No | Address |
| Newsgroups | Store-and-forward | Forum | Global | Text | Yes | Replication |
| FTP | Store-and-forward | Forum | Global | Text | Yes | Server |
| Web News | Store-and-forward | Forum | Global | Text | Yes | URL |
| Email Lists | Store-and-forward | Forum | Constrained | Text | No | Address |
| Collaborative Hypertext | Store-and-forward | Forum | Constrained | Text, Graphics | Yes | Replication |
| World Wide Web | Store-and-forward | Broadcast | Global | Text, Audio, Graphics, Video | - | URL |
| Internet Radio | Store-and-forward | Broadcast | Global | Audio | - | Server |
| Shared Whiteboard | Real-time | Person-to-Person | Global | Text, Graphics | Yes | Machine |
| PowWow | Real-time | Forum | Global | Text, Audio | No | Machine |
| Virtual Places | Real-time | Forum | Global | Text, Audio, | No | URL |

| | | | | | | |
|----------------------|-----------|------------------|-------------|-------------------------------------|-----|---------|
| | | | | Graphics, Avatar | | |
| Virtual Environments | Real-time | Forum | Global | Text, Audio, Graphics, Avatar | No | Server |
| Talk | Real-time | Person-to-Person | Global | Text | No | Machine |
| Internet Phone | Real-time | Person-to-Person | Global | Audio | No | Machine |
| IRC | Real-time | Forum | Global | Text | No | Server |
| Web Chat | Real-time | Forum | Global | Text, Graphics | Yes | URL |
| Video Conferencing | Real-time | Forum | Global | Audio, Video | No | Machine |
| MU* | Real-time | Forum | Constrained | Text | No | Server |
| WOO | Real-time | Forum | Constrained | Text, Graphics | No | Server |
| Agora | Both | Forum | Global | Text | Yes | URL |
| Bulletin Boards | Both | Forum | Constrained | Text | * | Server |

Table 1: Properties of Internet Communications Tools

Available Tools

Although new tools for Internet communication are always being released, most can be grouped into a limited number of categories. The following listing attempts to cover as many tools as possible with, though the listing is probably not complete. In some cases, a single product will sport a number of separate tools, retaining each tool's strengths and weaknesses.

Each of the following groups of tools can be categorized in terms of the properties given in the previous section (Table 1). Some tool groups are represented only a single product (indicated by italics on the table) so are named after the unique tool.

Email

Email allows text messages to be composed and then sent to an individual or series of individuals. Each message passes through a number of machines until it comes to rest on the machine that hosts the recipient's mail, where it remains until it is explicitly retrieved by the recipient. This is the oldest form of communication on the Internet, originally making use of simple machine-to-machine copying and explicit delivery paths. These explicit paths and the convoluted addressing they required have been superseded by a sophisticated domain name handling, vastly simplifying email addressing.

Newsgroups

The Internet newsgroup system allows for text messages to be sent to a newsgroup, usually focused around a certain issue or topic of discussion. This allows for people to choose which type of messages they wish to read and reply to. News articles are stored in a single place on a local server, and updated through a file replication scheme where each machine copies new articles to all other connected machines. Thus articles spanning a period of time are always available for perusal. This allows for 'casual' readership of newsgroups, where someone might occasionally check a number of newsgroups for articles whose subjects look interesting. This also allows new readers to trace back through the recent history of discussion in order to get a feel for the conversational style found among regular contributors to a certain group, giving them an opportunity to integrate themselves into the conversation inconspicuously.

File Transfer Protocol

Although rarely thought of as a communications tool, messages stored in files and in the names of directories allow users of these file repositories to communicate in rudimentary fashion with one another. Generally used by members of an underground file repository to make requests for certain files, or to tell others about other such repositories, the messages are usually written in a shorthand jargon in order to take as little space as possible.

Email Lists

Email lists, like newsgroups, are organized around a topic, but are not as widely available, nor do they support occasional readership. By leveraging of the email protocol, lists redistribute any single message among all subscribers, so each message becomes part of members' email. If one is not explicitly subscribed to a list, it is not possible to read any of the articles, though it is possible to blindly send a message to it. Thus readership is constrained to a known group of list subscribers.

Web News

Discussion groups can also be hosted within web pages. This usually involves the use of CGI (Common Gateway Interface) scripts on the server that handle the various aspects of maintaining a threaded discussion group. To the user, it appears as though the various messages are contained within a web page.

Collaborative Hypertext

A number of GroupWare systems also distribute articles, but instead of reaching an Internet-wide audience, the participants are members of an organization. Corporate memory systems such as Lotus Notes, and educational systems such as CSILE [16] are examples of such systems. In addition to text, most such systems also support graphics, and some support considerable more diverse media types, including applets. A growing number of such systems use the Internet as a means of interconnection, and theoretically, given the appropriate access, could be used by anyone on the Internet.

World Wide Web

The web is used as a broadcast medium used by people who construct web pages representing their interests or themselves and make them available to browsing by other web users. In addition to individuals, businesses and organizations use the web to advertise their presence and provide information. These messages can make use of text, graphics, video, audio, and any of the other growing number of media of the WWW.

Internet Radio

Internet radio tools, such as RealAudio, (<http://www.realaudio.com>) provide the means to playback a stored sound file without having to bring all of it down from the server on which it resides. This allows for a broadcast similar to AM radio, except that specific content can be heard by an individual at any time, rather than the set times enforced by a scheduled radio broadcast. It is also possible to listen to live broadcasts with these tools, if the content needs to be up-to-the-minute.

These tools work in conjunction with the World-Wide Web as helper applications. Selecting a web link that points to a file of this type initiates playback of the sound, and at that point it can be paused, rewound or fast-forwarded in addition to being played linearly.

Shared Whiteboard

Internet whiteboard applications allow two people to view a shared drawing space. In addition to simple graphics, writing on the board can be used for communication, though whiteboard applications are generally combined with other Internet communications systems, particularly video conferencing applications. There are a large number of protocols and specific applications used for shared whiteboards, some of which are commercial, and many more of which are limited use academic systems.

PowWow

PowWow from Tribal Voice (<http://www.tribal.com>) is another tool for communication between web users, however it is not able to display others within a web page. A connection must be made explicitly between two or more PowWow users, at which point they are able to communicate using text or audio, and are able to direct one another to web pages.

Virtual Places

Virtual Places, developed by Ubique (<http://www.ubique.com>) allows people to see others that are visiting the same web page as they are. Each person using Virtual Places is represented by a small graphic, generally a picture of a head, which has a position within a web page. By manipulating the

position of the head (a sort of Avatar), a user can take advantage of 'virtual furniture' within a web-page, to put themselves into virtual vehicles in order to participate in tours, and to initiate conversations by placing themselves adjacent to others. When two avatars are beside one another, they can communicate either using text, or, if there are only two participants, using audio through an Internet phone connection.

Web site tours can be initiated by anyone; a small vehicle appears and anyone who has moved their representation onto the vehicle when the tour operator moves to another web page moves to the new page with them. Tour members can engage in conversation with one another, but cannot explore pages not visited by the tour operator.

Virtual Environments

A new class of communication tools presents the user with a virtual space in which to communicate. One such tool, WorldsChat, presents users with a first-person three-dimensional world through which they can navigate [8]. As they navigate through a virtual space divided into a series of rooms, they are able to see others exploring the space, and if they get sufficiently close to, and are in the same room as, the representation of another user or users, they can converse with those people. By providing a three-dimensional representation of the environment and the users, clues such as the facing of others can indicate what they might be focusing on, which could be a message left by someone else on a wall, or another participant, for instance.

A large number of multi-player games also fall into this category. Although not all support voice communications, they all represent the player in the space defined by the game. Although the primary purpose of the space is game play, all provide means to communicate with other players. The avatars supported by multi-player games can either be two or three-dimensional, depending on the structure of the game.

Talk

Talk is a simple system where two people can see what one another are typing; basically a formalization of a number of screen mirroring techniques that allowed this type of communication to occur on early Internet systems. It is the only text-based real-time communication system that shows the

typing of another as it happens; all the others send a sentence after it has been completed, allowing for editing within a single utterance.

Internet Phone

Internet Phone applications allow audio connections between two people. Audio compression techniques allow for conversations to take place with only slight delays at each end, even with low-speed Internet connections. Connecting to an individual requires their Internet address, though users can be found through other means, such as through IRC.

Internet Relay Chat

Internet relay chat, or IRC, is a system in which groups of people can communicate with each other using real-time text. IRC servers have a worldwide usership, with individuals attending to one or more of thousands of 'channels' generally based on subject of interest. Each channel can have its own culture, including known veteran members, conversational styles, and automated participants known as 'bots' [13]. This often makes it difficult for a new member to become an equal participant within a channel, a problem found with many of the tools where the history of communication is not open to examination by new users.

Web Chat

Web-based chat systems are similar to single channel Internet Chat systems, except that they occur within a web page and thus can support limited graphic communication, generally used to include pictures of the conversants. Originally, limitations in the web protocol did not allow for automatic transmission of new utterances, so explicit requests for conversation updates were required. Some browsers now support timed or server-driven updating, and the use of new interactive technologies such as Java and Macromedia Shockwave has resulted in a more dynamic (and natural) systems. There are fair number of these newer tools, including Gamelan Chat and talk.com which are implemented as Java applets, and Ichat, which is implemented as a browser plug-in.

Some web chat systems, like WebTalk [9] are similar to Virtual Places and Agora, in that they are designed to give an awareness of others in an

arbitrary web page, rather than having a web page dedicated to the tool.

Desktop Video Conferencing

Video conferencing applications such as CUSeeMe, allow for audio and video communication across the Internet. Generally such connections are person-to-person between anyone on the Internet with appropriate hardware, though forums can be set up by using a reflector, where everyone connected can be seen by anyone else connected to the same reflector. Unfortunately if such a group gets too large, the video can become excessively slow to update, and voice communication can break up. The bandwidth and synchronization required by video is significant, and it can often be difficult to maintain an efficient person-to-person communication on the asynchronous packet-based Internet, let alone maintain multiple connections.

Multi-user Environments (MU*s)

MU* is generic term for a series of systems which include MUDs, MUSHes, MOOs and MUSEs, among others. Each of these systems allows one to explore around an imaginary space and to communicate with other people that are encountered within the space. Most MU*s are limited to text as their only medium, though this does allow for a much simpler construction of the spaces, as they need only be described. When a number of people are in the same space, they can talk to one another and perform simple actions, and the room often becomes very similar to a channel in IRC except that rather than gathering based on subject interest, conversations arise among those in virtual proximity. This encourages exploration of the space, which might either be constructed by a select few or may be constructed by all the members of a system.

MU*s have been extensively examined as social constructs [6, 17]. A large range of social phenomena have been studied within the confines of the simulated worlds [2, 3, 4, 5, 7, 14].

WOO

A WOO (Web MOO) is a MU* augmented by web pages for each of the spaces. Although movement among these spaces can occur with the graphical environment of the web pages, communication with others, as well as other actions, must occur in a text-based Telnet session running alongside a web browser.

The addition of web graphics allows those who construct the spaces to give others a clearer picture of those spaces, and allows members to illustrate their environment, but graphics cannot generally be used in conversation, though graphics in the environment might be 'pointed out' in conversation.

Agora

Agora [10] is designed to sit within the content of a web page. Like Virtual Places and some web chat systems, it shows who is browsing the same information and allows communication with them. In addition to real-time text communication, Agora supports a number of asynchronous methods of communication; a single threaded newsgroup, a person-to-person mail system, a history of recent visitors, and a persistent user profile that can be read by others.

Bulletin Boards

Bulletin boards are an interesting special case of application types. Most bulletin board systems, whether designed to run on the Internet, or to be accessed through local dial-up, support the features of IRC, email and newsgroups. However, they limit use to members of the particular board, thus creating a constrained user base.

By providing a broad range of tools (though all text based) to a limited set of users, bulletin boards are often able to support a long-standing community.

Conclusion

The number of tools available for online communication is ever increasing. The taxonomy of tools given here captures most of the major categories of the tools in use as of this writing. In researching the communities supported by these tools, the properties that make each tool different need to be considered. In addition, it is important to note the similarities between the tools, so that social phenomena observed in one tool might be extended to other tools. The properties of the medium exert a strong force on the character of the communities it hosts. The means of communication initiation, the conversational media, the style of interaction and the

constraints placed on membership are important factors to consider when attempting to explain online behaviour. The role of dialog history and the differences between store-and-forward and real-time interactions are pivotal in the initiation of new members into online groups.

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