The InfoLab

The world of information has changed dramatically. On the Web, Internet, and Intranets, information has become inextricably linked to the computer. Yet as people and organizations find themselves relying more and more on online tools for information gathering, the gap between those tools and the people that use them is widening.

The **Intelligent Information Laboratory (InfoLab)** is dedicated to bridging this gap between human information needs and the ability of computers to meet them. The focus of the **InfoLab** is on information and how both humans and machines interact with it. This translates into an interest in information presentation, and knowledge management; and that translates into work on interfaces, user profiling, and alternative metaphors for human/computer interaction. The **InfoLab** is driven by the desire to develop new ideas and to facilitate their transfer into working systems.

**Find Me Systems** are a series of projects designed to aid people in navigating large information spaces such as restaurant and movie databases. [Kris Hammond](mailto:hammond@ils.nwu.edu)

**Entrée** is a restaurant agent that uses its knowledge of cuisine, service and other important features to suggest new restaurants to users. Taking one restaurant from a user, the system returns with, “If you liked X, you’ll love Y.”

**Pick A Flick** is a video navigator that is able to find and suggest films. Pick A Flick suggests films based on similarity to ones you tell it you like.

**Watson** researches online for you. As you work, Watson uses your browsing and editing choices to bring back information before you need to ask for it. [Jay Budzik](mailto:jay.budzik@ils.nwu.edu)

**Rosetta** indexes information based on how it is referenced. By observing how others have used and described documents, Rosetta is able to be more precise in classifying the information in its database. [Shannon Bradshaw](mailto:shannon.bradshaw@ils.nwu.edu)

**Point/Counterpoint**, like Watson, is designed to conduct online searches with the specific goal of finding contrasting points of view. [Marko Krema](mailto:marko.krema@ils.nwu.edu), [Larry Birnbaum](mailto:larry.birnbaum@ils.nwu.edu)

**NoDaSE** reads documents and analyzes them for usable content. Building complete databases out of collections of web pages, it creates order out of the chaos of the internet. [Brad Adelberg](mailto:brad.adelberg@ils.nwu.edu)

**Q&A** is a Web-based system that allows page owners to organically create their own repository of frequently-asked questions while simultaneously creating a semantically indexed searchable corporate memory. [Jay Budzik](mailto:jay.budzik@ils.nwu.edu)

**Jabberwocky** teams voice recognition and presentation assistance to free the user from having to run a slide show alone. Jabberwocky simply listens to what is going on and is able to run the presentation itself. [David Franklin](mailto:dfranklin@ils.nwu.edu)

**The Intelligent Classroom Project**: This is a project in planning and perception in which the classroom itself observes a lecturer’s activity and acts to facilitate his plans. [Joshua Flachsbart](mailto:jflachsb@ils.nwu.edu), [David Franklin](mailto:dfranklin@ils.nwu.edu)

**Columbus** is a project in adversarial planning in multi-agent domains. The core of the work is in the area of negotiation within the context of competing at the game Settlers of Catan. [Robb Thomas](mailto:robb.thomas@ils.nwu.edu)

**Whisper Space** takes you into museums in a whole new way. Now you can listen in on and talk with art experts, guests, and even the artist herself. If a comment piques your interest, more information is immediately available. [Robin Huncke](mailto:robin.huncke@ils.nwu.edu), [Seth Tissue](mailto:seth.tissue@ils.nwu.edu)

**L21** brings together web surfing, instant chatting, and on-point recommendation. This collaboration tool provides an environment for people to save and share information, creating new on-line communities as they do so. [Xiaobin Fu](mailto:xiaobin.fu@ils.nwu.edu)

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*The work at the InfoLab is funded in part by grants from the National Science Foundation and McKinsey and Company, and a gift from Microsoft research.*
Find Me Systems

The InfoLab’s **Find Me Systems** are designed to make navigating through information spaces easier and more fruitful. Our **assisted browsing** approach aids in guiding the user through large information collections such as those found on the World Wide Web. Using seemingly simple questions, the system is able to gauge the user’s needs and tastes and make appropriate recommendations without the user ever having to formulate a query. Essentially, these systems provide you with a personal set of specialized concierges and salespeople. **Find Me Systems** are for the user who has a general idea of, “I’ll know it when I see it…”, Two examples, **Entrée** and **Pick A Flick** follow.

**Entrée** is a restaurant finder. The system recommends restaurants based on sets of different criteria as seen at left. You can start with providing a model for a restaurant like one you’d like to go to, or just by giving the system examples of what you are looking for in a restaurant. These systems have an inherent understanding that if you are satisfied with the selection brought back to you, you will stop looking. Therefore, there is a tweaking mechanism built in. You can keep expanding your search just by altering the criteria set as much or as little as, you want. The system is designed to deal with the goal you have – finding a place to eat – not a query you formulate. It also is equipped to handle issues of trade-off, such as the cuisine you want not being available in the price range you are looking for, and adjusts and informs you appropriately.

**Pick A Flick** is a video navigator that functions as an interactive version of the “employee recommendation” shelf at any video store. **Pick A Flick** asks for a movie you know you already like, and then begins to look for movies that are similar. Similarity can be based on genre, actors, or directors. The system has an encyclopedic memory of movies, saving you from having to spend hours wandering around reading titles and hoping they are what you want. **Pick A Flick** also provides a summary of the movie it suggests, so you can be sure its what you want.

Like **Entrée**, **Pick A Flick** can also continue searching, each time gaining valuable information about you and your choices.

Each one of the **Find Me Systems** is an expert on a particular kind of information, extracting information on demand as part of the user’s exploration of a complex domain. In **Find Me Systems**, you are an integral part of the knowledge discovery process, elaborating information needs simply by interacting with the system; the system knows about the trade-offs, category boundaries, and useful search strategies in the domain. Our aim is to build systems that can help users even when they do not have a lot of specific knowledge. InfoLab’s **Find Me** systems perform the needed function of making qualified recommendations in a world of ever expanding information resources.

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Browsing with Watson

While the World Wide Web is an invaluable and incalculable source of information, right now only the most persistent of researchers can wade their way through the redundant and often irrelevant results conventional search engines retrieve. The InfoLab’s Watson, a personal information management system, takes existing browsers further, making them more efficient and easier to use. By knowing about the user and the user’s needs, Watson is able to retrieve information without having to be asked or told to find information.

Watson profiles you as you work. It watches what you choose, what you don’t choose, and how you work. Armed with this information about you, Watson continues the search for relevant information, mining not only the Internet, but also internal and proprietary resources, continuously making suggestions as you work. With Watson’s knowledge of sources and of you, it will be able to anticipate your needs.

Often, a simple query will retrieve thousands if not hundreds of thousands of documents. Browsers crudely organize the results using a simple semantic analysis. While this is a good way to make a first sort, the number of results returned to the user is still overwhelming, and many of them are actually the same. Watson looks at the title of the document, the URL, and the date the document was last modified. All three of these identifiers are included with the results retrieved by your current browser. By using the information at hand in a more specific way, Watson can cut the number of results foisted upon the user by half or even more, eliminating redundancy without forfeiting accuracy.

This user is looking for information about Taiwan’s reunification with China. While the user is investigating this site, Watson continues the search. Whereas AltaVista had over 1,200,00 hits for the query “Taiwan Reunification China”, Watson brings back a manageable number of suggestions. Watson found several archived articles from the general press in addition to web sites, all while this user was looking at something else. Watson is able to direct the search for relevant documents even more once it observes what the user finds relevant. The more it sees the user work, the more specific Watson can get with its independent search. This insures that the retrieved information will be relevant to the actual task at hand, and not send the user off in a peripheral direction, or on a hunt through extraneous documents and graphics.

Watson actually brings you more useful information than current browsers do, even while reducing the number of documents retrieved for you – and you have to ask a question or compose a query. Watson does all the work. Watson is the first in a new wave of “just-in-time” information systems.

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Writing with Watson

The InfoLab’s Watson, a personal information management system, turns your current word processor and web browser into an intelligent research librarian. With Watson you can simultaneously research and write, and strengthen your argument as you use the information retrieved for you. Targeting web, internal, and proprietary resources, Watson finds both textual and graphic material relevant to the document as it is being written.

When you select from a set of templates, you give the computer its first information about you. Watson observes you and understands the type of document you are creating - a doctoral dissertation, a business proposal, a personal letter, and so on. The templates are designed to assist the system in their searches; with the knowledge of the type of document, it has a much better starting point from which to look for material. It also enables the system to make its first decisions about style and layout for captions and citations, while still being able to customize to your needs.

As the system retrieves and suggests texts and graphics, all you have to do is pick and choose which you would like to investigate further. Watson also filters information, sorting the overwhelming mass of information that conventional search engines return. By analyzing both source and retrieved documents for content and eliminating redundant URLs, Watson focuses on pertinent results and clusters them into semantically relevant categories.

For example, a user is writing a paper on Gandhi. Watson is searching for and suggesting related documents, and when the user wants a figure, Watson has several ready. An unsorted search of web would have thousands of hits (AltaVista’s result group for a simple query “Nehru and Gandhi” totals about 99,000), but Watson brought back a manageable number of higher-quality suggestions. The system will create the citation for the picture the user has chosen and for text quoted from a document in the paper. Meanwhile, the user continues to write the paper, and Watson continues to search for more information.

Most importantly, Watson cues off of you. As you decide which to examine or even add to your paper, the system observes the kind of information that is useful – as well as useless. With the knowledge the system has of sources, and the experience gained from working for you, we expect Watson to anticipate your needs and bring you what you need for the task at hand Watson is the first in a new wave of “just-in-time” information systems.

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InfoLab’s Rosetta is an indexing system for on-line searches. Usually searches are indexed by evaluating word frequency, but Rosetta is an entirely new approach. Rosetta discerns how a document has been used in the past. It establishes its index by mining and evaluating citations associated with the retrieved documents. The user is then presented with links to information sources more relevant to what they need than a conventional search engine is able to provide. By going backwards into the retrieved documents, Rosetta takes searching forward.

With Rosetta, you computer essentially acts as a reference librarian. After you type your query in everyday English, it is analyzed by the system. Rosetta extracts words useful in establishing context and content; those words then lay the groundwork for the search for relevant documents. The system then takes the words to which it has ascribed importance and begins to search accessible documents. Usually an information system indexes a document based on the words it uses most frequently. Rosetta introduces a new evolving mapping between the words people use to refer to a particular topic and documents which contain information on that topic. The documents are assessed not based on word frequency, but on how they have been employed and defined in the past.

When Rosetta has completed its search, it brings you the results in format that not only allows you to get the gist of the retrieved document, but also provides a link directly to that document. If Rosetta can not find a document that is entirely relevant to your query, it brings you documents that match up in a less complete way. It will then discern how you interact with the result group. Rosetta notes how you use a document, which you choose to read and which you bypass, and that information is stored in the system for your benefit and for the benefit of later users. With the information it has about the previous searches, Rosetta makes a more qualified judgement of the document’s relevance than current systems. When the new query is put through the system, Rosetta has information gained earlier from which to find what you want. Each time a description of information content is paired with a document, that pairing is used to expand the systems knowledge of word uses and how best to match a query to the documents the user would like to read.

The combination of the more natural interface and the increased accuracy makes Rosetta better than common indexing systems. By providing these links found by mining the references to be found within a recommendation, Rosetta provides higher efficiency and ease for the user. Like personal assistants, InfoLab’s new systems work for you – specifically.

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The InfoLab’s **Point/Counterpoint** is a personal information management system that has a very specific purpose. Like InfoLab’s Watson, **Point/Counterpoint** tracks the user’s work, but instead of bringing back general information, this system brings back opposing arguments. Whether the user is a journalist, a student, a consumer, or anyone putting together an opinion paper, **Point/Counterpoint** profiles that user and provides both sides to the issue under discussion.

**Point/Counterpoint** co-exists with your current word processor, and does its own search independently as you continue to write. When you write an opinion, you cite experts to back up your position. To strengthen that argument, you need to answer questions about the opposing view. As you insert a citation into your document, **Point/Counterpoint** detects the topic. Once you cite a person by name, **Point/Counterpoint** brings this name back to its table of experts and makes a match. Once this is done, **Point/Counterpoint** builds a query with which to search for related information and sends this query to a search engine. It then filters the results group before presenting it to you, so that you will not be overwhelmed by information.

**Point/Counterpoint** is able to search the Internet, Intranets, Web, and proprietary sources for documents you can cite and debate so as to persuade your audience. **Point/Counterpoint** also acquires information about which experts will be of the most value to you by observing how you interact with the options it brings back for you. If you choose one counter-expert over another one, **Point/Counterpoint** observes and notes this for later.

For example, if you are writing about Newt Gingrich’s opinions on universal healthcare, **Point/Counterpoint**’s table will match him up with Bill Clinton, and build a query to find information about Bill Clinton’s opinions on universal healthcare. The same can be done for opinions regarding economic theory, public funding for the arts, and any number of topics. In addition, **Point/Counterpoint** brings back a manageable amount of information from a wide variety of sources.

**Point/Counterpoint**’s ability to profile you also means that it will be able to predict your needs after it gains enough information about you and the kind of documents you find useful. It will have then information you need ready at hand when you want it. By automatically presenting both sides, **Point/Counterpoint** cuts down on time spent researching and browsing, and yet makes sure you have enough information to make a balanced argument. **Point/Counterpoint** is another example of the InfoLab’s just-in-time information systems.

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Often computer users need a specific answer to a specific question, but are forced to do a general search of the Internet. Not only does this waste time, but the user has to do all the work himself. The InfoLab’s Q & A is a much easier and faster way to find the answer.

You simply ask Q & A your question in natural language. The system takes your question to a database and, if the question has been asked and answered before, it retrieves the answer for you. Q & A is able to find a match even between paraphrases by using natural language processing techniques. Q & A also provides access to human experts in several fields. If it does not have an answer for you Q & A will forward the question to one of these experts. The expert will send you the answer and assign the question and answer to a category, so the information is saved and available for future users.

Here is an example of Q & A as it was seen at the 1996 Democratic Convention. Information about the convention, the city of Chicago and surrounding areas was made easily accessible to conventioneers. Instead of having to try to figure out which section of the newspaper or which web site might have the information being sought, people could just ask. Commonly answered questions were preprogrammed with links to answers…

With a conventional search of the Internet, you have to figure out the proper way to input your question and then wade through pages and pages of hits, then go off to visit web sites – when all you wanted was a simple answer. Q & A is without a doubt easier to use. You can type like you talk and the program understands you. Q & A has a sophisticated knowledge of lexical semantics, and adeptly analyzes your question in reference to subjects about which it already has information. In addition, with its knowledge of question-topic association, it can distinguish similar words and synonyms; therefore assuring that the answer you get is to the question you asked. So, once you pose your question, the program does the rest of the work for you. Q & A finds the answers and experts completely on its own, and presents the found information in an easily readable way. Q & A also anticipates additional information you might want; for example, a question about where to eat would link you to a restaurant finding program, and if you are looking for directions, Q & A will bring you a map.

With the more natural interface, your computer becomes easier to use and more effective. While doing a search of the whole Internet is necessary at times, the shortest distance between two points is a straight line. InfoLab’s Q & A provides the direct route between question and answer.
The amount of structured data available to information analysts is growing at a rapid pace, but there remains a need for new tools to capture this data from more unstructured sources. The Northwestern Document Structure Extractor (NoDoSE) is such a tool. It is a system for extracting structured data from semistructured text. NoDoSE is able to evaluate a page of text, and create a database because of its knowledge of layout and structure. In this way, what was almost instantly rendered obsolete in its original form is transformed into searchable and usable information.

A great deal of useful data currently resides in conventional database management systems, but a large and growing portion is not. For example, while the World Wide Web continues to expand, the query facilities for using the available information is very limited. In addition, the results themselves are represented as web pages which are difficult to use in other computer applications. Recently, there has been a flurry of work on systems to bring data from web sources within the use of other general tools. However, a vast quantity of semistructured data stored in electric form is not in highly formatted pages, but in text files on local file systems. Also, print material scanned into a computer will be read as a plain text files, without useful tags. Therefore, NoDoSE has been created to handle plain text files, and since highly formatted pages are simply a special case of text files, a tool for one is a tool for both.

Without clues about the format of a document, no system will be able to differentiate useful from useless. However, this does not mean that systems need to have complete descriptions about the structure of a document to function. With NoDoSE, a limited number of clues go a very long way. If a user indicates a few of the regions of a document that are interesting, it may be possible to identify similar regions automatically. NoDoSE therefore acts a semi-automated system. It cooperates with the user to extract data.

The information is given to the extractor as a set of documents that are instances of the same document type. For example, the files might contain the table of contents of a scientific journal, one file per journal issue. The user only has to take one of the documents and define it with NoDoSE. The definition is made by outlining the interesting regions of the document, and then describing what the region’s semantics. This process continues from the top-level regions through the rest of the document. While this might sound complicated, the process is expedited by a mining component that attempts to infer the grammar of the file from the information the user has given the system already. Once this process has been completed for one document, all the documents can be similarly analyzed.

NoDoSE interacts with the user in an intuitive way, gathering enough hints about the structure of documents to allow its format to be inferred quickly but without requiring so much interaction that the user becomes frustrated. Further, by interacting with the information analyst, NoDoSE is able to outperform both fully automated approaches and human users. NoDoSE makes information easier to use, transfer, and translate.
Jabberwocky is the newest in a series of presentation assistance systems from InfoLab. Jabberwocky frees the user from having to run a slide presentation himself, and from having to find an assistant. Jabberwocky functions both in the real world and the digital world, bridging the gap between the speaker and the equipment he relies on to get his point across. The system simply listens to the user and is able to run the presentation itself.

Jabberwocky works by bringing current voice and visual recognition systems into a productive interaction with presentation programs. The system is able to analyze the slides in the presentation and make educated assumptions about their attributes, such as words or graphics, on them. Using a probabilistic approach, Bayes’ Law, allows us to design a system that is able to operate at a high level while only having a shallow level of understanding.

Current voice recognition systems operate at about 75% accuracy. Since Jabberwocky uses a shallow recognition, that imperfection is accommodated for because the system is actually only listening for key words that appear on the slide or indicatory words such as “table” or “graph.” Other words are passed through the system, and analyzed for semantic and grammatical similarities to such key words, or are thrown out of consideration as unimportant. Jabberwocky listens for words that pertain to specific slides, allowing it to effortlessly operate even when the planned flow of a presentation is altered. This means that a slide being referred to by a question will be pulled up, and that the most applicable slide will be shown during the talk, regardless of any pre-set order.

There are no special requirements placed on the user in the designing of his presentation. Jabberwocky does its analysis on its own and automatically provides extra assistance to the user. For example, it inserts a “button” that will appear on the screen when the slide is shown. The user is able to bypass the system and change slides himself both by “pushing” this button or by calling for, “Next slide.” If the user does bypass the system, the system notices. When that presentation is given again, the system is able to recognize where in the lecture the speaker was when the slides were changed, and it will now be able to act on this without the user having to do anything.

This ability use context and learn is what sets Jabberwocky apart from similar systems. By observing the user and keeping track of such things, it allows the user an even higher level of freedom the next time the lecture is given. A word the system previously misheard is added to words that the system uses to run the presentation. This also allows Jabberwocky to function at continually higher levels, even though voice recognition is not perfect. Because the system is freed from trying to understand what is going on, it is able to simply do its work.

Jabberwocky is a part of the InfoLab’s “just-in-time” information systems. Jabberwocky provides the slide when the user needs it, without the user having to ask for it.
Many speakers, whether they are professors, business people, or board members, often find it a daunting task to prepare presentations. Without a guarantee that the location where he or she is speaking has the kind of equipment necessary for displays, it is usually easier to forego using videos or slides and just remain content with a straight talk. Unfortunately, this intimidation and aggravation can lead to presentations that are at best atavistic, and at worst dull. What is necessary is an environment that is equipped to run as many kinds of media as possible, and does as much of the work for the speaker as possible. It is for this reason that InfoLab is developing The Intelligent Classroom.

The Intelligent Classroom functions not just as a room, but as an intelligent environment. The Intelligent Classroom uses video cameras and microphones to sense the motion, gestures and words of a speaker. It acts, in a sense, as if it is the audio-visual coordinator: controlling the setting of lights, displaying slides, playing videotapes. In an intelligent environment, the user and the environment work together in a unique manner; the user expresses what he wishes to do, and the environment recognizes his intentions and attempts to accommodate the user. The Intelligent Classroom is designed to allow the user to interact with it in as natural a manner as possible. While various remote controls and gesturing systems are either available or being created, The Intelligent Classroom will be able to understand what a speaker is doing, without an electrical or artificial prompt.

The system will be programmed to understand certain actions and will be able to get additional directions from the speaker. For example, if a speaker is moving towards the blackboard and picks up a piece of chalk, The Intelligent Classroom will know that the time for slides has passed, and to bring up the lights. The speaker can also give the system an outline for the presentation, making it even easier. If the talk is running behind, all the speaker needs to do is say something along the lines of, “Let’s go right to the conclusion.” The Intelligent Classroom will be able to understand enough of the spoken word and of natural gestures to be able to predict what the speaker wants done.

Another benefit to a system like this is that it opens better possibilities for distance learning or long distance meetings. While most videotaped presentations are often crude and amateurish, The Intelligent Classroom can function as a director for the presentation. The Intelligent Classroom is already watching what the speaker does and making choices about how to respond to it. Beyond knowing when to turn the lights on and off, it will also be able to focus in on various parts of the presentation. If, for example, a speaker is standing still, the camera might zoom in on his or her face. The Intelligent Classroom is observant enough to notice if a speaker is highly animated, in which case a full body shot would be more appropriate. Since it is equipped with cameras and microphones, making a tape of the presentation is very easy. That tape will be of higher quality, as well as more interesting, than before, simply because The Intelligent Classroom knows how to watch and listen to a presentation.

Through a project like The Intelligent Classroom, cooperative behavior between computers and people is taken several steps forward. In addition, what we learn from The Intelligent Classroom holds strong possibilities for being implemented in game technology as well as in office desktop applications. In a sense, The Intelligent Classroom is InfoLab’s largest “just-in-time” system.
Planning for the growth of a company is often an intuitive process. Trying to take into account your own company’s goals, as well as those of your competitors, can be quite difficult. In order to be successful, you have to consider their plans and modify your own plan so that you can best achieve your goals. This kind of planning is called advisarial planning. Getting good at it requires practice. What InfoLab’s Columbus provides is a safe and entertaining way to get practice.

Advisarial planning allows us to succeed in competitive environments. All companies want 100% of their market, but only one of them can have it. In this kind of competition, advisarial planning is key to their marketing strategy. If two large companies agree to share the market and work together, they might succeed in monopolizing the entire market and squeezing out smaller competitors. Hammering out this new plan requires expert negotiation skills.

Games are often the subject of planning research because they provide micro-environments in which to test planning theories, while offering some of the challenges of the larger real-world domain. Columbus is an implementation of an agent that will play a board game called Settlers of Catan, a complex game that involves advisarial planning and negotiation. In the game, players compete to colonize a small island. Players must compete for the best building opportunities and locations. However, a player cannot build without the proper resources. If a player is short on a resource, she may also obtain it through trade. Thus, a successful player must have strong negotiation skills to support her building and production plans, and form and act on opinions about what other players want.

While the immediate use for Columbus is to practice planning, there are several opportunities within this framework. Right now, Columbus can help a person act in the real world, but beyond that is the possibility of further growth. Building intelligent agents that interact with people is part of the larger project of making agents that act in the real world. For example, Columbus’ technology could be used to build an agent that helps you shop. That agent would have to know about competitive pricing and sales techniques. Given this knowledge, it has to recognize that salespeople have plans and goals that are directly counterproductive to its own goals: the agent is trying to save you money and the salesperson is trying to get you to spend it.

Advisarial planning and negotiation are critical skills that one can only learn through experience. InfoLab’s Columbus provides a sheltered environment to gain some experience.

The work at the InfoLab is funded in part by grants from the National Science Foundation and McKinsey and Company, and a gift from Microsoft research.
InfoLab’s **Whisper Space** transforms the old guided tour at the museum into a fully interactive experience. Instead of listening to a tape, you can stroll through a museum and hear what other people have to say about the piece of art you are looking at. You can hear commentary from art experts, fellow museum guests, and sometimes even the artist himself. If at any time something someone has said piques your interest, you can choose to have that topic expounded upon.

**Whisper Space** works with the latest in voice recognition tools to make sure that the information being brought to you is on the right topic and that your comments are correctly interpreted as well. The system knows where you are in the museum and is able to tell what you are looking at. It then finds on-point commentary. The area around the painting you are looking at is equipped with speakers and you have a wireless headset. As you hear the whispers, you can participate by adding your own commentary, or asking for more information about a comment from someone else.

For example, if you were looking at Georges Seurat’s “A Sunday on La Grande Jatte” the whispering con-

If you were interested in getting more information about the connection between Van Gogh and Seurat, all you would have to do is tell the system. Or you could ask **Whisper Space** where the original studies are located. You can speak as naturally as you like, the system will understand you. It has access to an entire archive of information, which it will search, for more information. **Whisper Space** will retrieve data and begin speaking again. It has access to everything from academic papers to popular biography to the group of elementary students who came for their museum field trip. You can specify if you would like what you hear to be from experts or nonprofessionals, or you can let the system provide an aural collage.

**Whisper Space** brings together a variety of information sources in an easy to use and easy to control way; enhancing a trip to the museum simply by providing a stimulating conversation. **Whisper Space** is part of the InfoLab’s series of just-in-time information systems.

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121 takes many of the projects and concepts being developed at the InfoLab and brings them together in one place. Web surfing, instant chatting, and on-point recommendation are all included in this one package. 121 represents the next level in creating on-line communities.

121 works with your browser, and it is there every time you are working on-line. As you choose a page to open, it searches for a variety of personalized information for you. It seeks out other users who are viewing the same page at the time as well as users who viewed the page previously. It takes this data and provides you instant communication capabilities with people who are also on-line and the annotations of the earlier visitors. It saves information that you provide, and keeps it available to you while making it available to others only if you want it shared. In this way, people with common interests and research goals are put in contact with each other, fostering a higher level of communication. The concept of your “nearest neighbor” is no longer geographic, fulfilling InfoLab’s goal of making the Internet a central, social, and informative gathering place.

Here you can get an idea of how 121 works. A user has opened this page, and the system brings in Java applets with the live conversation that Julie and Jeff are having, recommendations for other pages to visit, and a WebNotebook entry from a previous visitor, Michele. The WebNotebook can be used to save and share information, such as personal annotations, addresses, citation information, etc.

121 also protects your privacy. When you participate in a chat, you can choose to make your identity and e-mail private or public. In this case, Julie only wanted to participate in the chat, but did not want to be contacted directly, Jeff and Michele provided links to contact them directly. If you decide to save a link to this site, you are Notebook annotation, which you can then decide if you want to make public or not. 121 Uses a Personal Digital Library, greatly improving on the older Favorites or Bookmarks list. You can also have the system update you on new information on subjects as others users register or add information.

InfoLab’s 121 brings the potential of the Web into view. Searching becomes a collaboration, instead of a solitary activity. You have the sharing of expertise of people who have similar interests. You can participate as much or as little as you like. 121 is part of InfoLab’s just-in-time information systems.