How will individual user interface technologies such as speech recognition, handwriting recognition, natural-language understanding, intelligent agents and virtual reality converge into a coherent user interface?

How can organizations gain competitive advantage by using advanced user interface technologies today and in the future?

How will the changing user interface revolutionize an organization's internal operations, customer contact and product marketing?

Reader Notes

Gartner Group's Advanced Technologies & Applications (ATA) service focuses its research agenda on the interaction among four core topics:

Advanced architectures: next-generation platforms, operating systems, middleware and application architectures that will become the foundation for enterprisewide infrastructures;

Advanced technologies: the maturity, applicability, future development path and projected penetration of key technologies;

Advanced solutions: business applications of advanced technologies and methodologies, including case studies of early adopters;

Advanced technology management: techniques and frameworks for evaluating, tracking, implementing and transferring advanced technologies throughout their life cycles.

The ATA service provides organizations with the tools to assess which technologies are relevant to their business problems, to guide them through the special issues associated with developing and fielding systems based on newer technologies, and to develop strategies for the next generation of information technology architectures.

User Interface Technology Drivers

Driver	*Activity*	*Technology*
 Employee Empowerment	Decision Support	Visualization
		Virtual Reality
	Filtering	Intelligent Agents
 Functional Complexity	Search	Text and Image Understanding
	Navigation	Speech Recognition
 Naive User Base	Command and Control	Handwriting Recognition
	Data Entry	

Source: Gartner Group

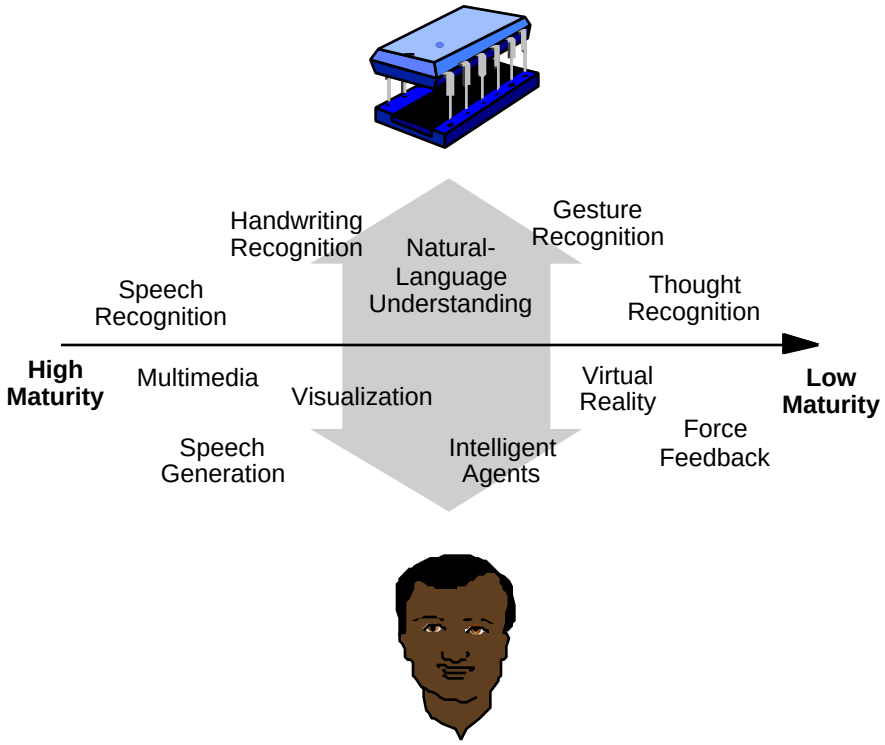
In the quest for more-natural, intuitive interactions between users and computers, constant improvements are taking place in such technologies as speech recognition, natural-language understanding, graphics and virtual reality. On rare occasions, a convergence occurs that generates a fundamentally new approach to human-computer interaction. Today, the user interface stands on the brink of such a convergence, one that will result in a new generation of user interfaces.

While GUIs have made computers accessible to a broader segment of the population than earlier interfaces, a number of factors are driving the need for a new generation of user interface. One such driver is the management focus on empowering teams and individuals in front-line positions to be responsible for a greater level of independent decision making; to achieve the potential that this approach offers, the employees must be provided with the tools to help them make sound judgments. A second driver is the increasing functional complexity of many products, which leads to interfaces with hundreds of options in embedded menus and icons. Finally, the rapid growth of PCs for home use is leading to a new class of users who view the computer as an entertainment appliance rather than a business tool and who consequently have different expectations and tolerances in terms of ease of use.

Key Issue

How will individual user interface technologies such as speech recognition, handwriting recognition, natural-language understanding, intelligent agents and virtual reality converge into a coherent user interface?

Reader Notes



Source: Gartner Group

The power of computers lies in their ability to store, manipulate and transport information in a way that is highly complementary to the cognitive capabilities of humans. However, the computer's ability to communicate with humans lags far behind its other capabilities, with the result that the major bottleneck in many of today's applications is the link between the computer and the most important multiprocessor in any task — the human brain.

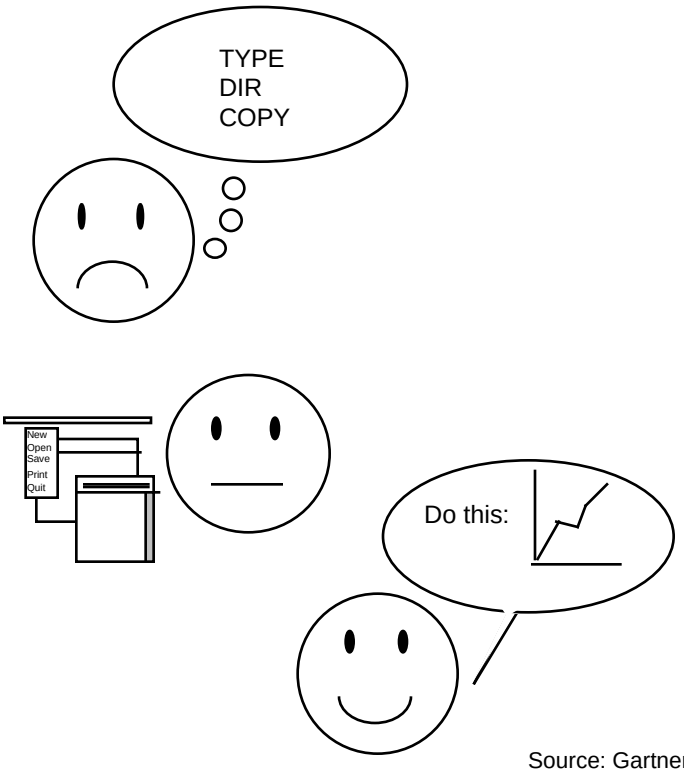
User interface researchers and product developers are constantly striving to create richer human-computer communications capabilities that will more fully realize the computer's potential to augment human understanding. Achieving this goal depends both on the flashes of insight and innovation that lead to fundamentally new interface paradigms, and on developments in the underlying technologies that can turn ideas into reality.

Until recently, the focus of user interface technology researchers was to develop the individual technologies to a stage where they could perform with acceptable accuracy and usability. Now that a growing number of the new technologies are reaching a useful level of maturity, there is a new emphasis on understanding how the technologies can be used together and integrated into the larger computing environment.

Computer interfaces, which 10 years ago were recall based, and which now are recognition based, will evolve into multimodal user interfaces based on more-natural human communications to serve a wider range of users (0.8 probability).

Reader Notes

User Interface 2000



Source: Gartner Group

Key Issue: How will individual user interface technologies such as speech recognition, handwriting recognition, natural-language understanding, intelligent agents and virtual reality converge into a coherent user interface?

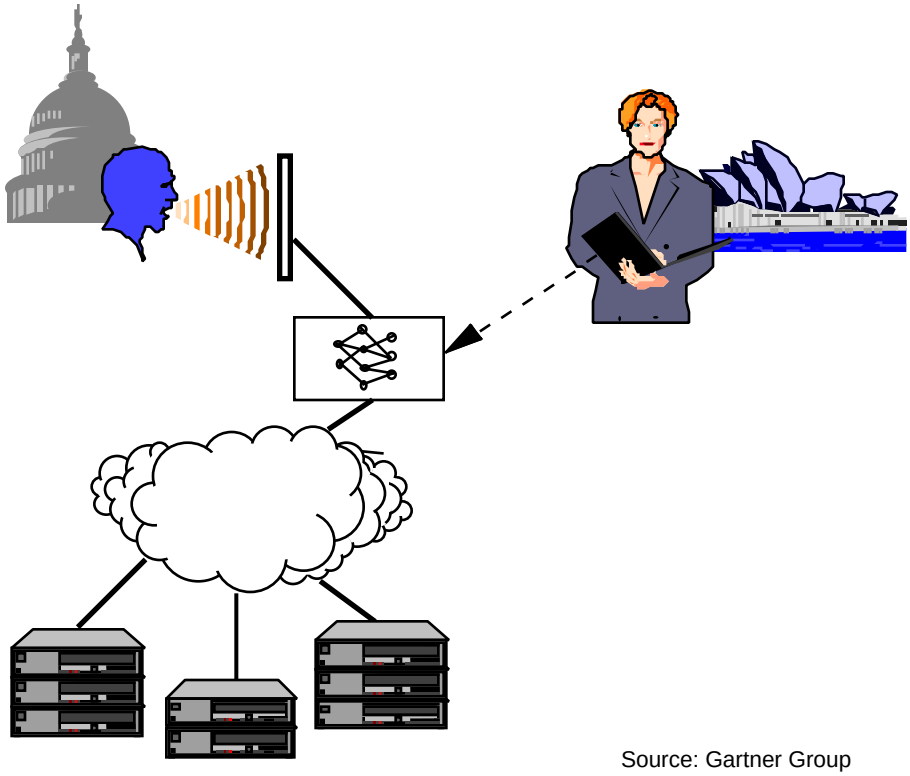
The first generation of interactive user interfaces was recall based, i.e., command line user interfaces that required the user to learn a special language for each new package or application. The second generation is today's recognition-based GUI that uses menus and icons to show the user the options that are available.

To make complex functions accessible to naive users, designers are creating user interfaces that are more closely aligned with the way humans interact with each other and with their environment (e.g., through speech dialogues, gestures and three-dimensional sight and sound). Interfaces based on these more-natural communication techniques are returning to a recall-based approach, only this time around the computer has taken a major step toward learning the user's language. The next generation of user interface — the multimodal user interface (MUI) — will be characterized by the availability of multiple methods of user input, dominated by those techniques that offer more-intuitive interactions (e.g., speech recognition).

By 2000, the benefits of location transparency and ubiquitous information access will convince the end-user community that local applications, local files and other workstation-centric phenomena are inferior methods of operation to a user-centric model (0.7 probability).

Reader Notes

User Interface 2005



Source: Gartner Group

Key Issue: How will individual user interface technologies such as speech recognition, handwriting recognition, natural-language understanding, intelligent agents and virtual reality converge into a coherent user interface?

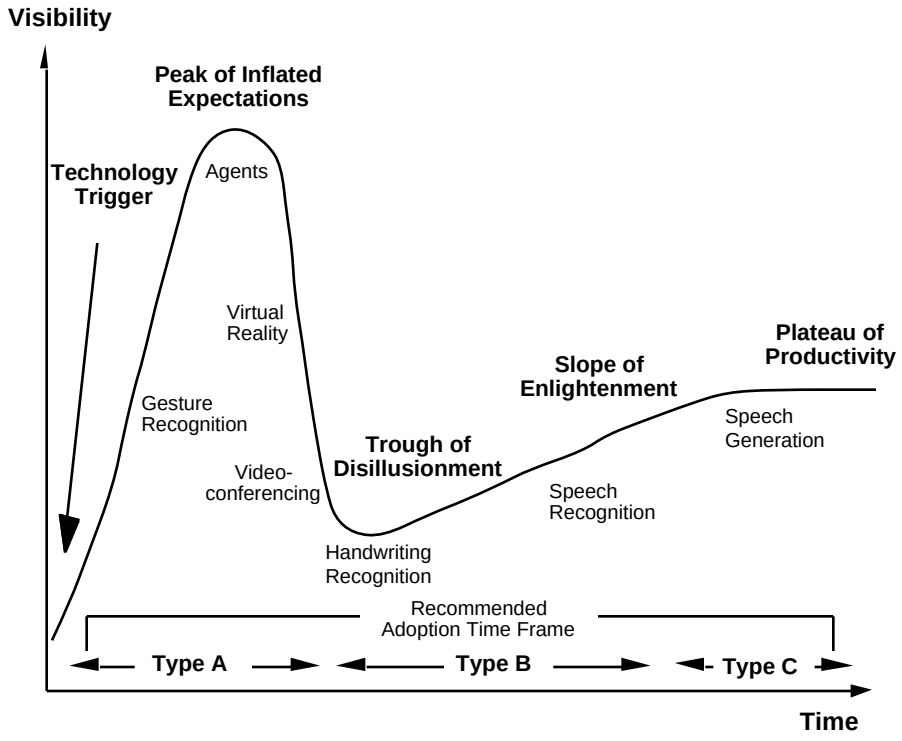
Beyond the next generation of multimodal user interfaces, interaction methods will continue to map more and more closely onto human communication capabilities. In addition, a fundamentally new philosophy — ubiquitous computing — will begin to make itself felt by 2000 and will make significant commercial inroads into home and office environments by 2005.

The premise of ubiquitous computing is that computing power will be embedded in the objects and environments people encounter as they go about their daily lives. This is obviously a long-term goal, since the immensity of the user interface issues (i.e., naive users in public places performing complex tasks) is matched only by the complexity of the architectural ones (e.g., massive central repositories, wireless infrastructures supporting many items in close proximity). However, the idea of specialized devices for specific tasks is a logical extension to the multimodal user interface. Whereas the multimodal user interfaces of the next few years will provide an optimal user interface for each task performed on a general-purpose device (e.g., a PC), ubiquitous computing will optimize the device itself for each specific task.

How can organizations gain competitive advantage by using advanced user interface technologies today and in the future?

Reader Notes

The Hype Cycle of Advanced Technologies



Source: Gartner Group

In deciding which technologies to investigate or deploy, an organization must consider four main factors: the relevance of the technology to the organization's key business issues, the status of technology adoption within the organization, the maturity of the technologies under consideration and the organization's tolerance for risk in relation to its desire to stay ahead of the competition. Once an organization has decided that a particular emerging technology will play a role in its future business processes, it must determine the optimal time for seriously investing in the technology. This is no easy task. If the organization launches its efforts too soon, it will suffer unnecessarily through the painful and expensive lessons associated with deploying an immature technology. If it delays for too long, it runs the even greater risk of being left behind by competitors that have successfully made the technology work to their advantage. The problem can be eased significantly by understanding the "hype cycle" of emerging technologies.

Most technologies follow a predictable life cycle of hype, disillusionment, realism and (eventually) productivity. By tracking a technology's progress along the hype cycle, planners can determine when its maturity reaches a point compatible with their own tolerance for risk.

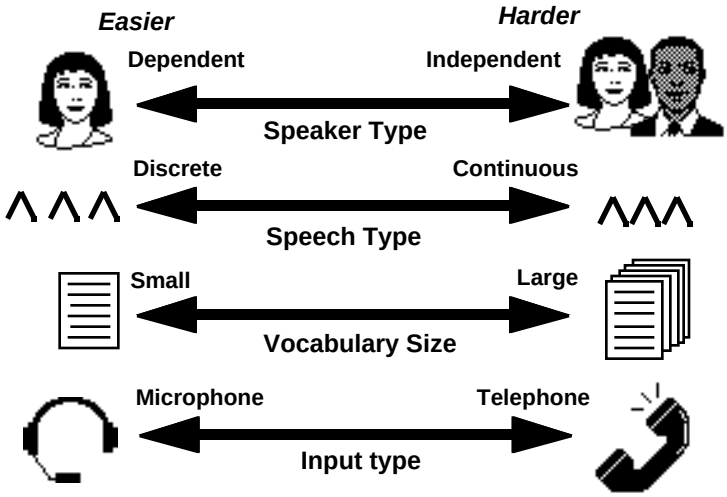
Today, organizations should consider speech recognition only when there is a specific reason not to use a keyboard.

Reader Notes

Speech Recognition Applications

Data Entry Hands/eyes busy Naive user	**Telephone** Replace touch-tone Hands/eyes busy
Dictation Replace transcription Keyboard disabilities	**Computer/Consumer Device Control** Naive user, more options

Speech Recognition Technology



Source: Gartner Group

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The enormous increases in processing power during the last few years and some recent advances in speech-processing algorithms have created dramatic improvements in speech recognition technology. However, the current state of the art is such that users still have to have a solid reason to prefer speech over other data entry techniques. Examples of successful applications include mobile data entry, where users have their hands and eyes busy performing an activity (e.g., factory inspection), and dictation for users who are physically unable to use a keyboard (e.g., through repetitive stress injuries).

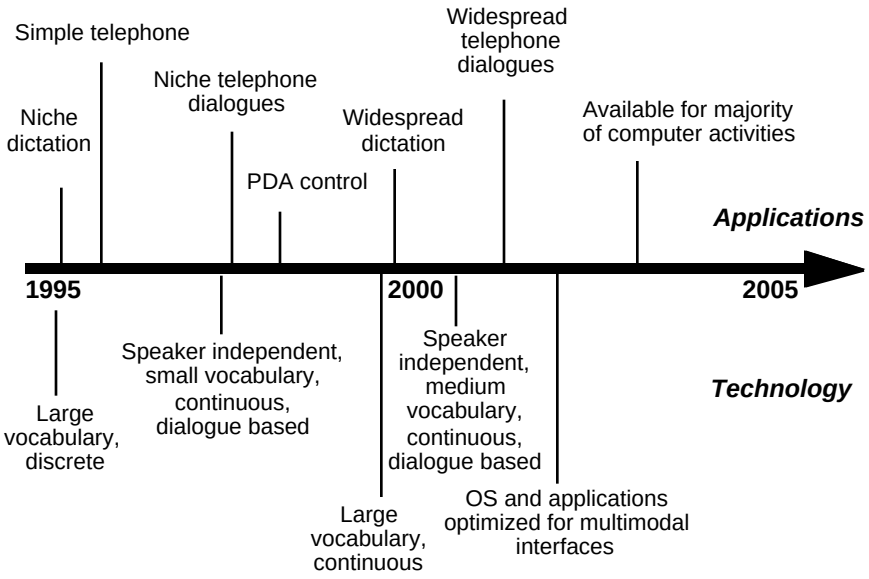
Even when targeting well-motivated users, applications must be constrained along one or more of the four axes (speaker type, speech type, vocabulary size and input type) that affect the accuracy of the speech recognition device. For example, the speech-to-text technology used in dictation systems must deal with large vocabularies (e.g., 30,000 to 60,000 words) and so requires a high-quality microphone and discrete mode of speech (i.e., with a brief pause after each word) to achieve real-time performance on today's desktop machines.

Reader Notes

Large-vocabulary dictation systems will remain a niche market until the technology supports real-time continuous-speech recognition with accuracy rates of around 97 percent to 98 percent. This will happen by 2000 (0.7 probability).

Task-focused natural-language speech telephone dialogues (e.g., travel booking) will be usable by motivated users by 1997 and by naive users by 1999 (0.7 probability).

Speech Recognition Time Line



Source: Gartner Group

Key Issue: How can organizations gain competitive advantage by using advanced user interface technologies today and in the future?

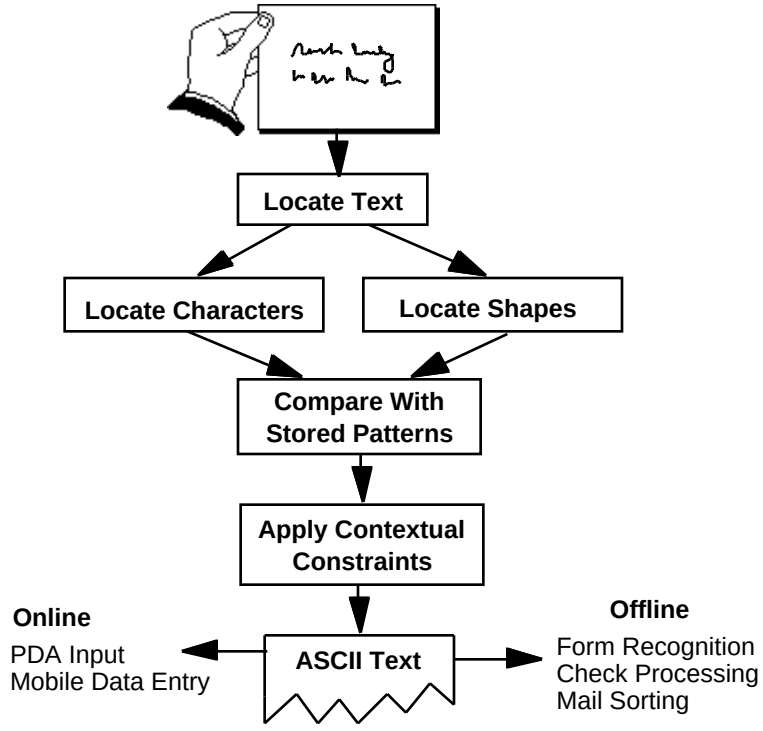
The feature that has triggered more-widespread acceptance of speech as an input modality for computer control, data entry and telephone applications is the ability to recognize continuous speech. Continuous recognition for free-form dictation is likely to hit the PC market within two years (Philips Dictation already offers a system that converts continuously spoken speech into text at around one and a half times slower than real time). However, reaching a broad segment of the user population will require an accuracy of 97 percent to 98 percent, integrated editing features and a means of filtering out surrounding conversations and other interruptions.

The next major development that will enable speech recognition to be applied to a broader range of applications will be the addition of natural-language understanding. Although full understanding of unconstrained natural language remains a distant goal of artificial intelligence, dialogue techniques, which can extract the core meaning from a user's natural answer to a specific question, are now being commercialized. Because of the unsuitability of the telephone keypad as an interface to anything beyond numeric entry, telephone applications will be among the first to deploy the technology broadly.

Today, organizations should consider handwriting recognition for offline form processing or limited-vocabulary mobile data entry.

Reader Notes

Handwriting Recognition Technology and Applications



Source: Gartner Group

Key Issue: How can organizations gain competitive advantage by using advanced user interface technologies today and in the future?

Despite the disastrous reputation that handwriting recognition gained from the early Newtons, the field is still in a growth phase. Of the two types of handwriting recognition (offline and online), offline currently yields the most benefits. Offline recognition involves reading paper forms that have been filled in by hand (e.g., insurance or loan applications, check processing, and tax forms). In well-designed applications, constraining the context and format of each field can yield a recognition accuracy at least as good as human operators entering the same data.

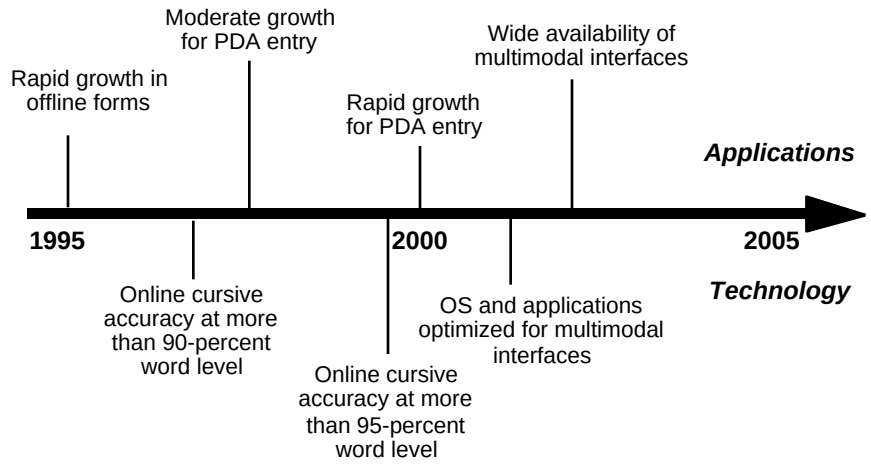
Online recognition is used in PDAs and mobile equipment as a direct input device to the computer. This is the more challenging problem and is the feature that was radically overhyped in the Newton. Since the first Newton, online recognition has improved considerably, but it will still be at least five years before it is accepted widely as a general-purpose input method. Current successes are focused on vertical-market applications, primarily for mobile workers (e.g., inspection, warehousing, and emergency services).

Reader Notes

By 1999, rapid advances in speech recognition will relegate use of handwriting recognition to situations where speech input is inappropriate (0.7 probability).

By 2000, cursive handwriting recognition will be offered as a standard interface option (along with other input techniques) on the majority of PDAs (0.7 probability).

Handwriting Recognition Time Line



Source: Gartner Group

Key Issue: How can organizations gain competitive advantage by using advanced user interface technologies today and in the future?

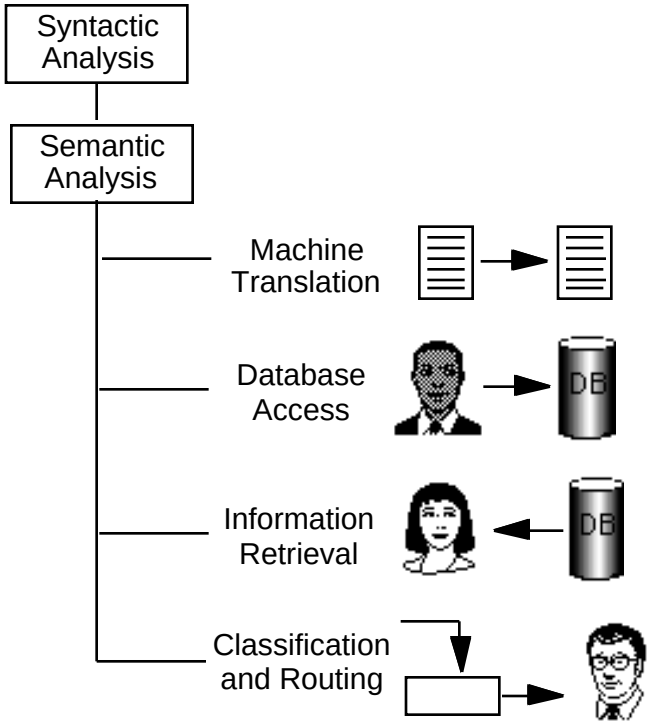
The most significant short-term growth in the handwriting recognition arena will be for offline applications, since the technology can already beat the accuracy of human operators in certain applications. Offline handwriting recognition will increasingly be offered as a standard component of OCR and document-processing systems. Even if only a small percentage of handwritten data entry can be automated reliably, considerable savings can still result.

To be broadly adopted, online handwriting recognition must offer more than its current 90-percent word-level accuracy. However, by the time it achieves acceptable accuracy, handwriting recognition will probably have been overtaken by speech recognition as the preferred input mode for small devices like PDAs. It will, however, retain a role as one of the multiple input techniques offered in the new multimodal user interfaces that will arrive as standard elements of applications and operating systems. This will enable the user to select handwriting recognition as the preferred input mode whenever circumstances dictate (e.g., for taking notes during a meeting).

Through 1998, natural-language understanding will remain a niche technology used mainly in information retrieval, machine translation, story classification and task-focused database access (0.8 probability).

Reader Notes

Natural-Language Understanding Technology and Applications



Source: Gartner Group

Key Issue: How can organizations gain competitive advantage by using advanced user interface technologies today and in the future?

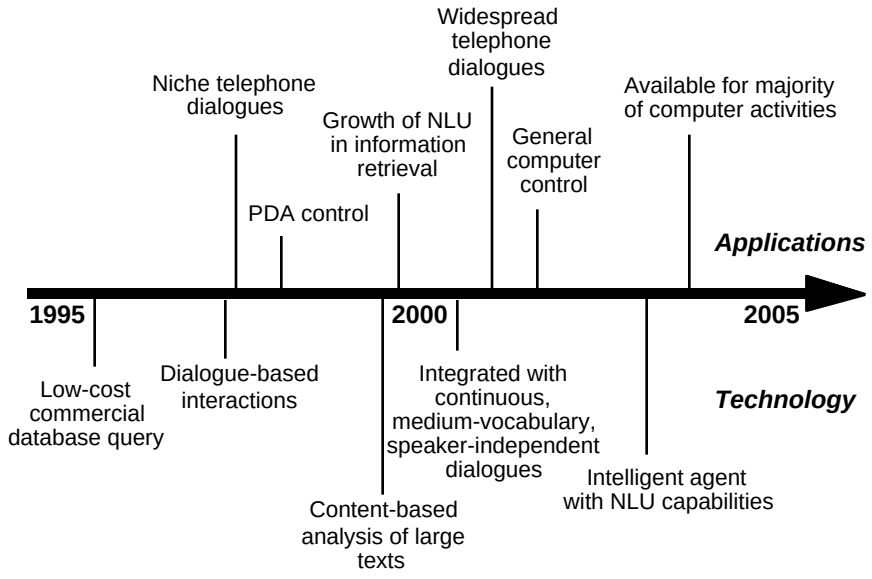
Following decades of research into one of the holy grails of human-computer interaction — a computer that understands requests, commands and texts expressed in a human language (e.g., English, Spanish, Japanese) — natural-language understanding technology is finally making inroads into commercial applications, albeit in niche areas. Machine translation systems can now translate documents from one language to another at around 80-percent accuracy (good enough for a first draft), and natural-language database query products translate focused information requests into the appropriate database language (e.g., SQL). Information retrieval systems are using increasingly sophisticated analyses to improve their recall/precision performance, while content understanding is being used to route and classify pieces of text such as news stories, bank telexes and military intelligence reports.

The key characteristic of natural-language understanding is that it performs a more thorough analysis of the structure and content of the text than other approaches (e.g., keyword searches in information retrieval). The depth of analysis varies from word-based (e.g., database queries) to a detailed consideration of the content (e.g., text classification).

By 1999, natural-language understanding will emerge from a niche technology into a mainstream user interface technique for command and control of computers and consumer devices (0.7 probability).

Reader Notes

Natural-Language Understanding Time Line



Source: Gartner Group

Key Issue: How can organizations gain competitive advantage by using advanced user interface technologies today and in the future?

In many respects, natural-language technology has ended up ahead of the industry's ability to integrate it into computer systems. The executives who claimed they would only use a computer if they could ask it questions in plain English now have that capability through commercial natural-language database interfaces, yet few avail themselves of such products. The principal users of natural-language interfaces are task-focused workers who must repeatedly query a database with related but differing questions (e.g., a warehouse manager with inventory queries). The executives are still waiting, not for a system that can understand their words, but for one that can understand their intent. This requires an additional layer of intelligent problem-solving behavior to map a broad range of requests or commands onto the application layer. This capability is arriving in the combination of speech dialogues, which are an efficient way to clarify ambiguous or unfocused requests, and intelligent agents, with their knowledge of external resources and their ability to personalize information. Together, speech dialogues and intelligent agents will broaden the use of natural language beyond its current niche into mainstream user interfaces.

Today, users should view intelligent agents as a metaphor rather than a technology and should evaluate products on the basis of specific functionalities rather than vague claims to incorporate agents.

Reader Notes

Intelligent Agent Functions and Applications

Characteristics System Roles	Autonomous	Knowledgeable	Teachable	Mobile	Personal	Observant
Guru (Personnel)		X				
Filter (Information retrieval)	X	X			X	
Guide (Microsoft "Bob")		X				
Watcher (Wizards)	X	X				X
Gopher (Telescript)	X	X		X		
Surrogate (Macros, workflow, network management)	X	(X)	(X)		X	X

Source: Gartner Group

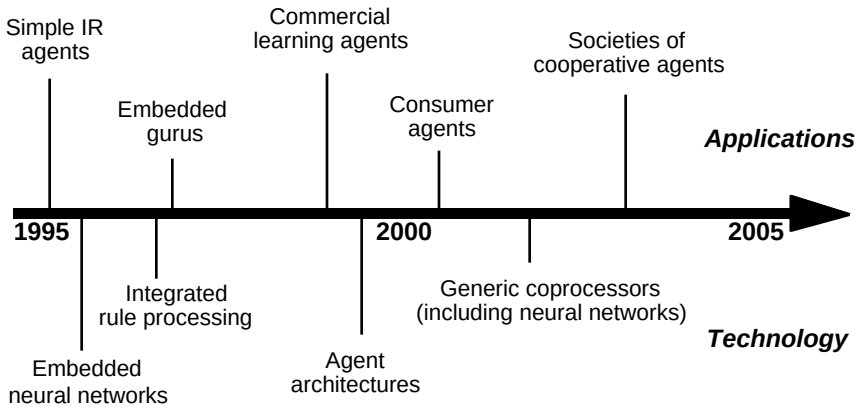
Key Issue: How can organizations gain competitive advantage by using advanced user interface technologies today and in the future?

One of the most difficult issues when dealing with intelligent agents is that of definition. Unlike object-oriented technology, which is rigorously defined by its adherence to inheritance, encapsulation and polymorphism, intelligent agents are currently defined by more-vague characteristics, such as being autonomous, proactive, customizable and knowledgeable. The term *agent* is used broadly in the industry to describe products that include a subset of this functionality, particularly those that encapsulate knowledge (about the user, processes or a specific topic) and have a sense of autonomy that allows the agent to act without continual direction from the user. Common examples are newswire filters, network monitoring, workflow and operating-system-level macros (e.g., for backups). Since most of today's systems use nothing unique in the way of technology (with the exception of learning agents and messaging technology like Telescript), they are better viewed as products with an agent metaphor, rather than products using agent technology. As with any other product purchase, buyers must look behind the hype and assess the extent to which the total product functionality meets their needs.

By 2000, a major new industry will have developed to provide agents with specialized knowledge for automating and assisting in specific tasks (0.6 probability).

Reader Notes

Intelligent-Agent Time Line



Source: Gartner Group

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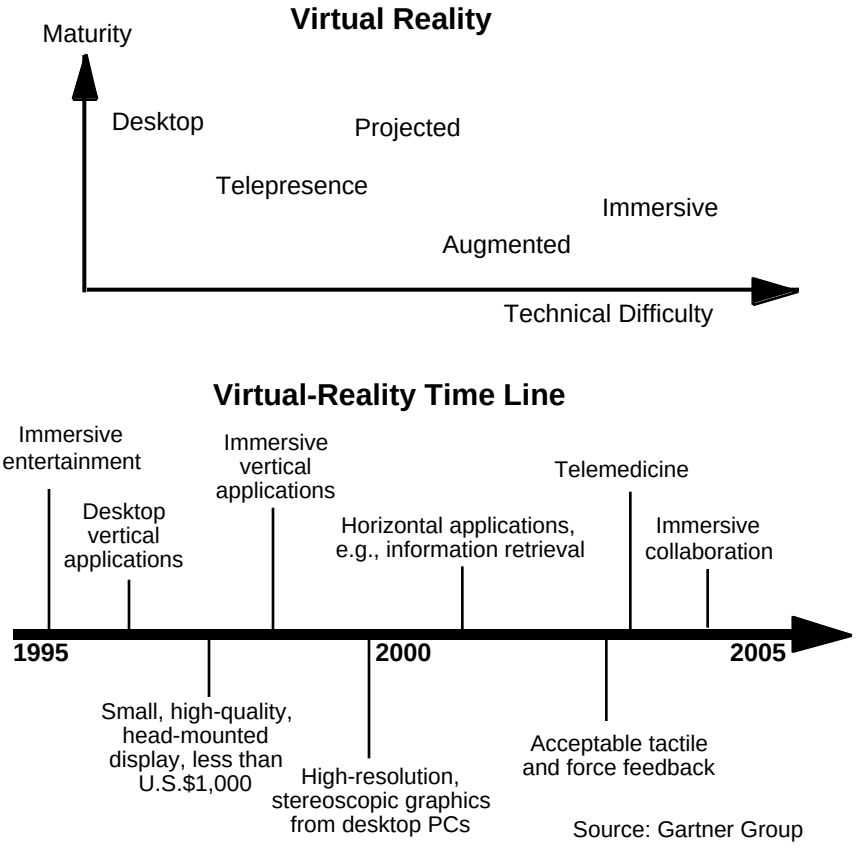
The promise of intelligent agents is greater than their current disorganized and overhyped commercial status would indicate. There are a number of distinct and important research areas that will lead to more-powerful agents, including:

- *Learning:* the ability to watch and act on the user's habits and preferences;
- *Mobility:* the ability of agents to move across different computer platforms;
- *End-user programming:* the provision of simple but powerful end-user interfaces for customizing agent behavior;
- *Collaboration:* architectures to support collaboration between multiple agents.

Once vendors of agent-based products can deliver on the expectations they are creating for personalized, proactive, proficient and perceptive assistants, intelligent agents will form a critical addition to the next-generation user interface. By providing an additional layer of decision making, agents will be able to improve the standard of communication by performing such tasks as determining how best to fulfill a user's request for information or deciding on an appropriate display method based on the nature of the information retrieved.

By 2001, virtual reality will achieve high-enough quality and a low-enough price to be used for horizontal tasks such as information retrieval (0.7 probability).

Reader Notes



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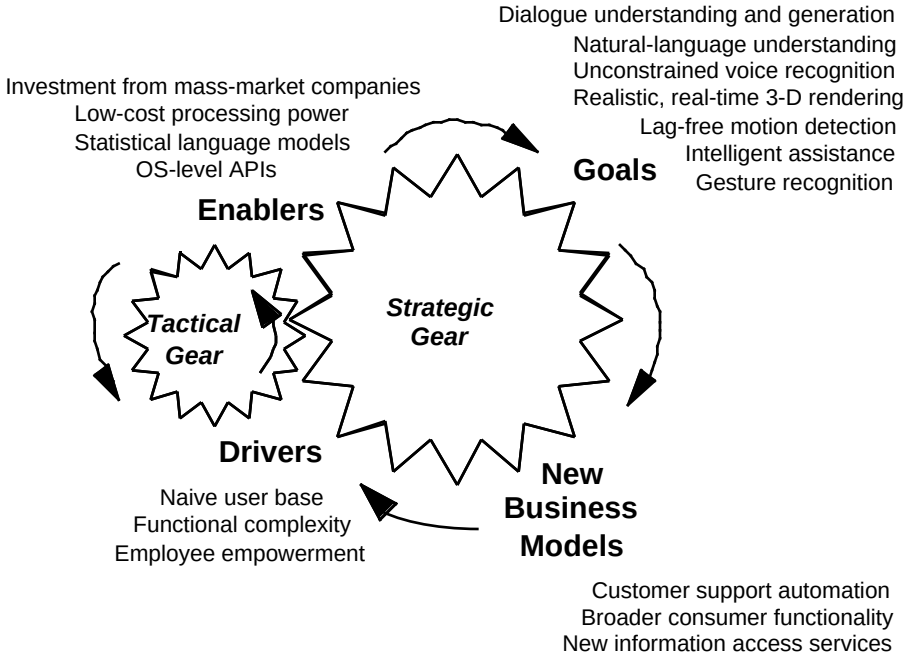
During the next few years, the use of virtual reality will grow rapidly in specific vertical applications where there is a pressing need (e.g., industrial design, financial visualization, and architecture). Extending its use into horizontal and general-purpose applications with only moderate added value, such as information retrieval, will require advances on the following fronts:

- *Graphics quality*: generating more realistic images and rendering — highly dependent on available processing power;
- *Head-mounted displays*: must be light and low cost and provide high resolution with a broad field of view — advances are being driven by the entertainment industry;
- *Tactile feedback*: important for touch and manual interaction with objects in the virtual world — currently one of the poorest aspects of most virtual-reality systems, with no immediate prospect of significant improvement.

How will the changing user interface revolutionize an organization's internal operations, customer contact and product marketing?

Reader Notes

Tactical and Strategic Impact of User Interface Technologies



Source: Gartner Group

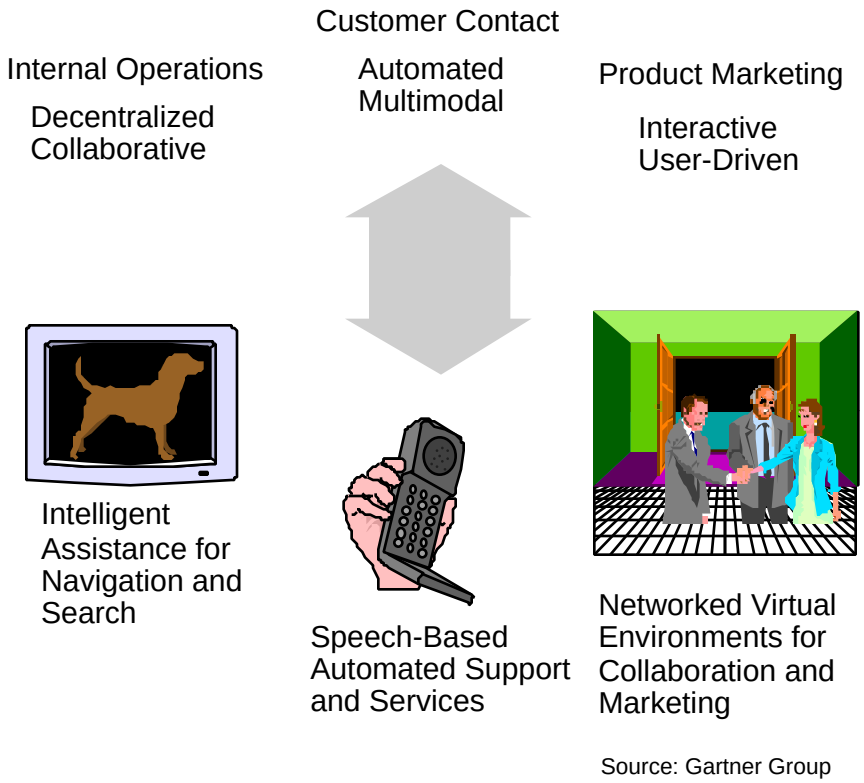
Current developments in the field of user interface technology can be leveraged in two ways. From a tactical perspective, the technology enablers (e.g., lower cost and higher accuracy) are advancing the individual technologies to a level where they can provide significant benefits to help solve the problems, or drivers, that a business is experiencing. For example, the improvement in PC processing power is making visualization of complex, abstract data accessible to users without a mathematical or statistical background.

On the strategic side, the business drivers and technology enablers converge periodically to make a significant stride toward achieving one or more of the current industry goals, or ideals, for the user interface (e.g., natural-language dialogue understanding). When this occurs, the resulting technological discontinuities create a fundamental shift in business models; for example, the availability of multimedia games on CD-ROM has fueled a massive growth in the consumer PC market that is now being exploited by online service providers such as CompuServe and America Online. In the same way that GUIs opened up applications to a whole new user base, the multimodal user interface represents another quantum leap forward that will make computing power available to a still broader market, particularly on the consumer side.

Multimodal user interfaces will attract a surge of new computer users (business and consumer) who will be able to perform complex navigation and decision making (0.7 probability).

Reader Notes

Impact of the Multimodal User Interface



Source: Gartner Group

Key Issue: How will the changing user interface revolutionize an organization's internal operations, customer contact and product marketing?

The potential of the multimodal user interface to simplify access to complex functionality will affect organizations on three fronts:

- *Internal operations:* The emphasis on collaboration will continue as computers allow users to share a single view of data (e.g., video, audio, animation and text). The trend toward decentralization will grow as employees have greater access to the information they need, in the form in which they need it.
- *Customer contact*: Customer interactions will be more highly automated than at present through dialogues using speech recognition and natural-language understanding. For live contact, customers will be able to select their preferred mode of interaction (e.g., video, audio or E-mail).
- *Product Marketing:* The growth of online services and interactive TV will thrust marketers fully into the entertainment business, as vendors vie to attract customers. Through filters and agents, users will be able to focus in on just the information that is of interest, so marketing material will have to be personalized and informative as well as entertaining.

Bottom Line

The next-generation user interface will provide computer users with a wide range of input and output modalities based on more-natural communication capabilities. This new generation of multimodal user interfaces will have dramatic consequences for the usability and prevalence of computing devices.

Organizations can gain tactical benefits from the selective application of such advanced technologies as speech recognition, handwriting recognition and virtual reality.

From a strategic perspective, organizations must prepare themselves for the new business models that will result from the multimodal user interface. The broader use of computing power will enable organizations to support growing organizational trends (e.g., decentralized decision making) and to generate new services and new methods of customer service and product marketing.

Reader Notes