MIT Media Laboratory

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**enabling technologies
for learning and expression
by people and machines**

The MIT Media Laboratory occupies a unique position in the rapidly evolving landscape of new media and information technologies. It was founded by MIT Professor Nicholas Negroponte and the late Jerome Wiesner (former science adviser to President John F. Kennedy and former president of MIT), who foresaw the coming convergence of computing, publishing, and broadcast, fueled by changes in the communications industry. As this convergence accelerated, it spurred interconnected developments in the unusual range of disciplines that the Laboratory brought together, including cognition, electronic music, graphic design, video, and holography, as well as work in computation and human-machine interfaces.

Since opening its doors in the fall of 1985, the Media Laboratory has pursued its educational and research mission, and helped create now-familiar areas such as digital video and multimedia. True to the vision of its founders, today's Laboratory continues to focus on the study, invention, and creative use of digital technologies to enhance the ways that people think, express, and communicate ideas, and explore new scientific frontiers.

The Laboratory is beginning the 21st century with a major expansion: a complex that will approximately double its current space. A new building will be adjacent—and connected—to the current Media Laboratory structure. When completed by 2005, the complex will house the Okawa Center, focused on the ways children will live, learn, and play in the digital age, and two additional centers: one focused on the underlying science and technology needed to merge the bits of the digital world with the atoms of the physical world; and another focused on arts and expression, which will explore new content as it evolves from new means.

The Laboratory is also undertaking major initiatives abroad. In May 2000, the Laboratory signed a 10-year collaboration with the Republic of Ireland to establish Media Lab Europe in Dublin. This independent, university-level educational center is expected to grow to a community of 20 faculty members and 35 full- and part-time research staff, more than 100 graduate students, and 100 undergraduates. To facilitate the free exchange of information, the MIT Media Laboratory and Media Lab Europe will share all intellectual property developed at both locations over the initial 10-year period.

In June 2001, MIT and the government of India announced a one-year exploratory project to create Media Lab Asia, which is conceived as an independent, nonprofit organization. Findings at the end of the program's first year will frame decisions concerning a 10-year Media Lab Asia project, and will determine the role that MIT would play in its development.

Academic Programs

Unlike other laboratories at MIT, the Media Laboratory comprises both a degree-granting academic program and a research program. The Laboratory's faculty, senior research staff, and visiting scientists number approximately 40; another 100 staff members support the Laboratory's research, facilities, and administration. Graduate enrollment totals 183; approximately 40 percent are PhD candidates and the remaining 60 percent are master's degree candidates. Of these students, 157 are enrolled in the Media Arts and Sciences program, while another 26 are formally based in other MIT departments, but carry out their research under the direction of Media Laboratory faculty. In addition, more than 200 undergraduates come to work at the Laboratory each year through MIT's Undergraduate Research Opportunities Program (UROP).

Research Consortia

Much of the Laboratory's work today is organized into five consortia, which are funded primarily by corporate sponsors. Many of the technologies and applications conceived within the consortium structure are tested and refined through experiments at MIT and in the field, in cooperation with individual member companies.

Changing Places (CP), a joint Media Laboratory and Department of Architecture consortium, explores how new technologies, materials, and strategies for design can make possible dynamic, evolving places that respond to the complexities of life. It is an expansion of MIT's House_n: The MIT Home of the Future consortium. Central to this research is the development of a home-scale, occupied "Living Laboratory"—an agile facility to test new design, construction, and digital infrastructure concepts. The Living Laboratory will enable ongoing scientific studies into the real-world impact of design and technology for preventative healthcare, energy/resource conservation, human-environment interfaces, and links between the home and changing places of healing, work, learning, and community.

Digital Life (DL) is redefining a connected world: a world built by everyone, for everyone, and filled with machines that react with natural behavior—bringing us more in touch with the human experience. The totality of this vision represents a shift in design and inventive approach from one based on adapting raw technology to one steered and motivated by the culture, intelligence, and expressive demands of the world at large. Research is centered around themes of:
• connectedness: developing basic technologies for embedded communications that serve social and personal goals;
• embodied presence: building systems that embody everyday common sense and social savvy; and
• consumers as producers: building new electronic interfaces that adjust to our needs rather than having us adjust to theirs.

Digital Nations (DN) aims to address major social challenges (improving education, enhancing healthcare, and supporting community development) through the innovative design and use of new technologies. The consortium's ultimate goal is to empower people in all walks of life to invent new opportunities for themselves and their societies. The consortium focuses especially on populations with the greatest needs: children and seniors, underserved communities, and developing nations.

information: organized (i:o), formerly News in the Future, seeks to further innovations in information technology and to understand how digital content can enhance the human experience. As the digital age continues to change the way that information is collected, presented, and disseminated to the public, i:o will respond by focusing its core research on three areas:
• description: "intelligent" machinery for describing and analyzing digital content;
• design: new, expressive modes of presentation and visualization of digital content; and
• debate: tools to engage "information consumers" in new types of discourse around digital content.

Things That Think (TTT) explores the migration of computation and communications out of conventional computers and into everyday objects. From smart construction kits that let children build things that are meaningful for them, to new musical instruments for virtuosic artists, to ultra-low-cost computers that provide rural-market access in developing countries, this effort is moving computing off the desktop in order to make it relevant to a broader constituency. As this once-quirky vision matures into a commercial reality, the work of TTT is growing to encompass the integration of the bits of the digital world with the atoms of the physical world, on scales ranging from atomic nuclei to global networks.

Special Interest Groups

The Laboratory has also organized a growing number of smaller, more focused special interest groups (SIGs) which deal with particular subject areas.

Broadercasting looks at the future of broadcast media;

CC++ looks at cars in the digital world;

Counter Intelligence is focused on developing a digitally connected, self-aware kitchen;

e-markets looks at transactions in a networked world, and explores the new social and economic order that may result;

Gray Matters considers the impact of computation and communication on the lives of older persons;

Health combines research in nanotechnology, biosensors, body networks, and smart homes to give consumers tools to control health and maintain a lifestyle;

IPID looks beyond low-cost tags to ask how billions of inexpensive communicating objects can be tied together into coherent systems;

Personal Fabrication is about using new techniques, and exploring the future of desktop fabrication;

Silicon Biology explores how micro- and nanoscale fabrication technologies offer new ways to understand, and ultimately control, complex biological systems; and

Toys of Tomorrow (TOT) explores ways that the digital revolution will transform the world of toys and play.

Facilities

The Media Laboratory houses an experimental, gigabit fiber-optic plant that connects a heterogeneous network of computers, ranging from fine-grained, embedded processors to supercomputers. The rapid prototyping resources include 3-D printing, injection molding, and PC board fabrication. There are studios for audio and video, and laboratories for DNA labeling, new sensors, micro-encapsulation, quantum computing, and perceptual studies.

Financial Support

In 2000-01, the Media Laboratory received more than $36 million from sponsors, an increase of 18 percent over the previous year. Corporations provided more than 95 percent of that amount, with the remainder coming from government funding, non-profit organizations, and subcontracts with other universities. The focus on corporate support reflects the Laboratory's commitment to collaborative research that has possibilities for a wide range of applications, and technology transfer that moves research results out of the Laboratory and into worldwide use. Geographically, 50 percent of the Laboratory's 140 sponsors have their headquarters in the Americas; 25 percent in Europe; and 25 percent in Asia. Businesses represented range from electronics to entertainment, furniture to finance, and toys to telecommunications.

Sponsorship

Many sponsors find the Laboratory to be a uniquely valuable resource for conducting research that is too costly or too "far out" to be accommodated within a corporate environment. The "multiplier" effect of joining a community of sponsors to support advanced research has impressive results. For less than the cost of one senior scientist's salary plus benefits, a sponsor can gain access to the work of a 400-person research laboratory. Currently, there are several levels of sponsorship available:

Affiliate sponsorship, at $100,000 per year for a minimum of three years, introduces sponsors to the overall work of the Laboratory. Companies may move on from this basic level (which includes limited access to intellectual property) to a higher level of sponsorship at any time. This level of sponsorship is designed primarily for start-ups and small companies.

Consortium sponsorship is the most frequently selected option. A consortium connects a group of sponsors with a group of Laboratory faculty and research staff focused on a common agenda. Consortia may range in size from 20 to 50 sponsors, with annual research budgets of several million dollars. The cost of joining a consortium is $200,000 per year, for a minimum of three years. Consortium sponsors receive full intellectual property rights—license-fee free and royalty free—to all work developed in the Laboratory during their sponsorship years.

Consortium members have the option to sponsor additional projects and people through:

Special interest groups, which provide more-focused research agendas for smaller numbers of companies. The cost of individual SIG memberships typically ranges from $75,000 to $100,000 per year.

Graduate fellows, which give sponsors the opportunity to connect with specific students and research groups in areas of particular interest to the company. The cost of supporting each fellow is $75,000 per year. Student fellows can carry the company name, and can rotate annually.

The highest level of expendable support is the **corporate research partner**. Such partners fund larger agendas at the Laboratory, including corporate fellows programs or special Laboratory facilities. Corporate research partners automatically become members of all consortia and SIGs, and have the right to an employee-in-residence at the Laboratory.

A parallel, **directed research** funding track is available to accommodate federally sponsored research and large-scale corporate contracts.

Consortia and SIGs have their own scheduled activities, including group meetings twice a year. In addition, all sponsors are welcome to visit the Laboratory at mutually convenient times, to see research in progress and discuss areas of common interest. Faculty members also travel to sponsor sites.

From time to time, the Laboratory organizes special events on particular themes. Periodically, it also hosts Laboratory-wide events that are open to representatives from all sponsor companies. In addition to offering presentations by outstanding speakers, such events provide an ideal environment for sponsors who share an interest in new technologies to meet one another.

The Laboratory maintains an extensive Web site (www.media.mit.edu) and publishes a newsletter, FRAMES, which keep sponsors up-to-date with research developments. Sponsors also have access to internal technical reports and unpublished research.

Intellectual Property

The Media Laboratory is unique among the laboratories, centers, and research programs at MIT in that full sponsors of the Laboratory have the opportunity to share in all of its intellectual property, license-fee free and royalty free. Non-sponsors are precluded from making use of the Laboratory's developments for at least two years after the filing of a patent or copyright.

As a result, the Laboratory is an intellectually open environment where ideas are readily exchanged, and is a community in which each sponsor is entitled to acquire non-exclusive licensing rights to all intellectual property that is conceived, developed, or reduced to practice. Over the years, this policy has fostered a large number of unexpected and highly successful solutions that have led to new technologies and products, greatly benefiting both sponsors and the world community.

A Sampling of Research Activities

The microfabrication of an **interferometric accelerometer** that offers advantages over existing accelerometers in terms of resolution, size, and potentially low cost. Lab researchers have manufactured 14 accelerometer devices capable of detecting accelerations at the micro-g and nano-g levels, on a single 4-inch silicon wafer.

A new technology to mass-produce **super-cheap transistors** by printing them directly onto a plastic substrate using a solution of cadmium selenide nanocrystals. This project won a 2001 *Discover* magazine Award for Technical Innovation.

Periscope, a browsing device that allows a user to explore the physical world by navigating its digital shadow-in this case, Web pages situated at the places they represent in the real world.

A prototype for a **hand-held, human-powered generator** that creates five watts of power by being twirled over a person's head by a string. The device has implications for providing affordable power for simple computers in the poorest and most remote areas of the globe.

Wireless "**digital town centers**," capable of providing even the most remote and underdeveloped areas of the world with telephone, e-mail, and Web access, bringing them new forms of medical care, education, entertainment, and commerce.

Wearable computing, which allows us to move beyond PCs and laptops and wear our computers as we would eyeglasses or clothing. One project, **MIThril**, combines light-weight processors, a single-cable power/data "body bus" and high-bandwidth wireless networking in a package that is nearly as light, comfortable, and unobtrusive as ordinary street clothing.

Expressive **synthetic characters** that inhabit virtual environments and interact autonomously in response to users' actions, appearing to have minds of their own.

New ways of joining the physical environment and cyberspace by making "**tangible bits**" accessible through everyday physical surfaces like walls or desktops, and eventually through household surfaces like refrigerator doors. One project, **ComTouch**, focuses on providing haptic, interpersonal communication, to help those who are the deaf and blind communicate through touch.

A new class of **low-cost, wireless sensors** that can be used to bring digital functionality to low-cost consumer products. An example would be a 5-cent wireless temperature sensor that could be embedded in cookware or packaging for food or medicine.

Expressive Footwear (sneakers to be exact) that sports a wireless suite of sensors, a microcomputer, and a data link that measures more than a dozen different parameters of motion and feeds this information wirelessly into a PC, which uses a unique program to turn the movements into sound. This project won a 2000 *Discover* magazine Award for Technical Innovation.

More effective, meaningful **online news services**. These range from **Time Frames**, a tool to make online news more relevant by augmenting a general news source with small amounts of temporally correlated information, to **Brico**, a computer knowledge base that utilizes the meaning of words to create "sense tagging" for multilingual translations.

Autonomous agents capable of having a real-time, face-to-face conversation with a human. These agents look human and communicate using both verbal and nonverbal modalities.

Chat Circles, an abstract graphical interface for synchronous conversation, creating a richer environment for online discussions.

New techniques for **information hiding**, including the groundbreaking use of mid-level vision models and the placement of unique identifiers on physical objects.

Toy Symphony, a three-year project involving children, soloists, composers, and symphony orchestras around the world, which aims to radically alter how children are introduced to music, and to redefine the relationship between professional musicians and young people.

A handheld **digital mirror** that serves as a simple, everyday diagnostic imaging tool for people to "photograph" health indicators, such as blood sugar levels or heart rate.

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