Ambient Intelligence in HomeLab





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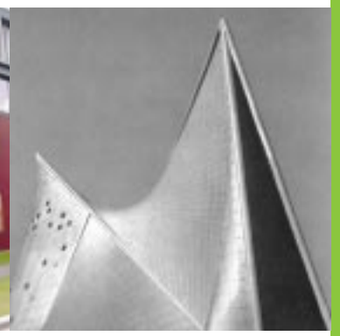
AMBIENT INTELLIGENCE

Ambient Intelligence in HomeLab

The invisible EXPERIENCE

Gerard Kleisterlee, CEO Philips



As we are driven to enhance people's lives, we want to know and fully understand how people interact with technology. We want to learn from them so we can make sure our innovations work for them. The HomeLab is a proof point for our dedication to this in the context of our Ambient Intelligence vision. The tremendous advances in wireless connectivity, speech technology and design enable us to bring advanced intelligent technologies into people's homes while being fully integrated in their personal environment. Ambient Intelligence is the vision that Philips uses to denote this new paradigm in consumer electronics, which completely changes the way we communicate and live. We view ourselves as one of the industry shapers that will turn this vision into reality. Philips has a long tradition in ambient intelligence. At the 1958 World Fair, we presented the very first multimedia presentation ever: *Le Poème Electronique*, created by the world-famous architect Le Corbusier, futurist Iannis Xenakis and composer Edgar Varèse. They envisioned a world striving for 'newness and harmony' using multimedia – at the time a brand new way for creative artists to express themselves. The three artists took it even a step further by integrating all the electronics into the pavilion's walls, making the experience 'ambient' and revolutionary for its day and triggering a whole new way of communicating ideas. I am sure that HomeLab will become the seminal research facility to help us understand better '*the moments people touch technology*'. At the same time, it will act as native soil for many technological innovations that will lead to the ultimate invisible experience enhancing and enriching the lives of people. ←

EXCELLENCE THROUGH technological leadership

HomeLab will serve a great purpose in the integration and deployment of Ambient Intelligence-related technologies in novel applications and at the same time will be used to better understand human interaction with this entire new world we try to create. It is a unique facility, well equipped and well positioned to exhibit our commitment to further technologies that enhance people's lives.
The realization of the Ambient Intelligence vision can only be achieved by combining a broad range of technologies with innovative product and service design. In a true Ambient Intelligence environment, all electronic features and functions are integrated into people's backgrounds. This requires full control over a wide spectrum of enabling technologies, ranging from micro-sized radio devices with autonomous power support, via all kinds of portable, wirelessly interconnected devices for personal communication, vast amounts of distributed storage functions, up to large wall-sized displays that support virtual and multimodal interaction. In the ultimate Ambient Intelligence environment, these components and systems are seamlessly integrated in such a way that they can be combined with extreme and opposite performance characteristics, so as to provide very large bandwidths using wireless connections or extremely high processing speeds at ultra-low power. These challenges very much fit the breadth and depth of our technology basis. This provides Philips with an almost unique opportunity to assuming leadership in this new domain of applications and to building a strong position in the many new markets that will be opened up by the developments in Ambient Intelligence. ←

Ad Huijser, CEO Philips Research, CTO Philips

Ambient Intelligence - EXPERIENCE TECHNOLOGY

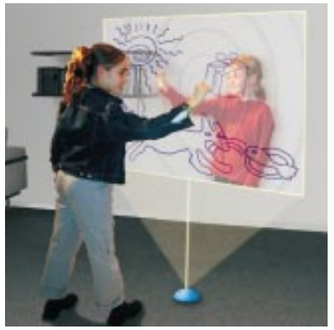
Emile Aarts

The paradigm

As a result of the ongoing miniaturization of electronic circuits and the corresponding exponential increase in embedded computational power, we have reached the point where it has become possible to integrate electronics into people's environments. However, the way we experience that computing power is about to change. The awesome buttons and menu options of present-day equipment will disappear, to be replaced by intelligent systems that we operate through user interfaces that are an extension of our natural speech and movements, through touch panels, heat and weight sensors, and intelligent cameras that track our eyeball movements. The intelligent system responds to and even anticipates our needs by the sound of our voice, the gestures of our hands and the expressions on our face. The corresponding paradigm is called Ambient Intelligence and it refers to electronic environments that are sensitive and responsive to the presence of people. It improves the quality of life by creating the desired atmosphere and functionality via intelligent, personalized interconnected systems and services. Ambient Intelligence environments are characterized by their ubiquity, transparency and intelligence. Ubiquity because the user is surrounded by a multitude of interconnected embedded systems. Transparency because the equipment is invisible and integrated into the background of the user's surroundings. Intelligence because the system is able to recognize the people that live in it, adapt itself to them, learn from their behaviour, and even show emotion.

Maximum enjoyment

Ambient Intelligence aims at enhancing our leisure experiences and enriching the quality of our lives. From choosing to record the TV programme that it knows we like to watch, to monitoring the efficiency of an exercise workout in order to improve our athletic performance, Ambient Intelligence systems will operate quietly in the background to make the experience more enjoyable. Unlike the paradigm of the desktop computer, which knows little more about us than our log-in name and password, Ambient Intelligence systems must know who we are and in which context we operate them. When we turn on our PC, for example, it has no way of knowing whether we are angry, sad or elated. And for most of the things that we do with our PC it does not matter. But for an Ambient Intelligence system that greets us when we get home, selects suitable background music and lighting, or advises us on the state of our health, recognizing what sort of mood we are in will be vitally important. The system must know when to keep quiet and when to speak up, what to say and what not to say, and it must recognize those times when we need to be left alone with our thoughts.



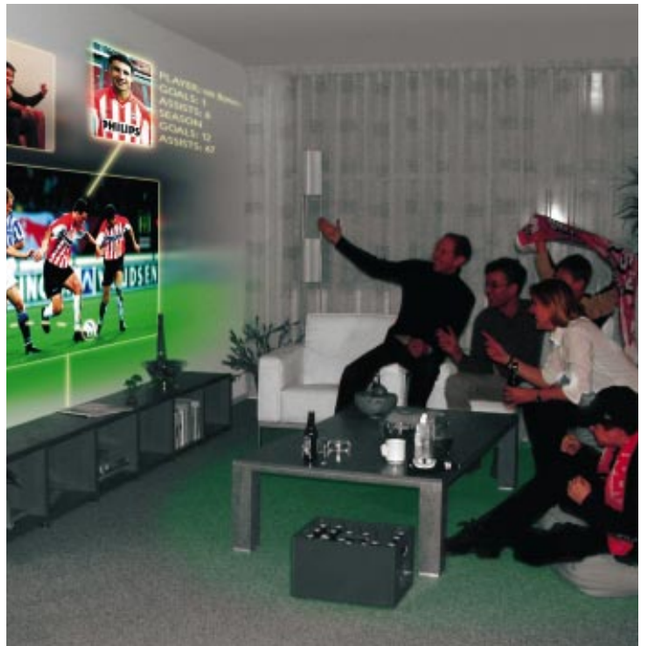
From vision to reality

Although turning this vision of Ambient Intelligence into reality involves some formidable challenges, Philips is in an ideal position to provide many of the solutions. For example, Philips is rapidly establishing itself as the world leader in set-top box technology for interactive TV. And it is the set-top box that will almost certainly evolve into the 'home beacon' that will use broadband communication channels to connect the Ambient Intelligence within our homes to that in the outside world. Philips is also a world leader in the RF communications technology required for wireless-based in-home digital networks, having developed ➜

low-cost silicon solutions for DECT (Digital Enhanced Cordless Telephony) and Bluetooth. And for the display-centric environment of Ambient Intelligence, Philips has solutions ranging from LCD modules for handheld devices to large-area flat-panel displays that can be built into the walls of a room. There are also new and unsolved challenges imposed by Ambient Intelligence. In terms of the computer science, issues such as quality of service, graceful degradation and load balancing need to be addressed. Protocols need to be established for peer-to-peer communication between computing nodes in self-configuring networks, algorithms need to be developed for resource location and management, and 'intelligent agent' technology needs to be developed so that applications can move around freely to locate resources and follow the user from one location to another.

A social system

Naturalizing the human interface poses even greater challenges. Not only must the technologies of speech, gesture and handwriting recognition be refined far beyond their current status, they must also be integrated into multi-modal models that combine information on gesture, voice intonation and facial expression to determine the semantics of conversational dialogues. Even the way we react to and use Ambient Intelligence, together with its social implications, will require considerable research. To investigate the practical, psychological and social implications of Ambient Intelligence, Philips Research will use its HomeLab, which is located at the Philips High Tech Campus in Eindhoven, The Netherlands. Comprising a fully equipped home, complete with living, sleeping and kitchen facilities, HomeLab will be equipped with a distributed embedded infrastructure in which Ambient Intelligence can be developed and investigated. As a window on how the home of the future might look, one thing is certain: it is sure to be an exciting place to live and work over the coming years. ←



The culture of AMBIENT INTELLIGENCE

A new modernity

The intelligent technologies emerging today are 'light'. Miniaturized and almost intangible, they can merge seamlessly into our environment: homes, offices, cars, streets, clothing – even ourselves. This means, for instance, that the home of tomorrow will look more like the home of yesterday than the home of today. The bulky boxes containing today's ageing technologies will disappear. Instead, the functions we need will be hidden in timeless objects, those that have been and always will be present: surfaces to sit on or put things on, containers, ornaments, and the walls, floors and roof that protect us from the elements.

Our environment will come 'alive' with intelligence. Objects that were formerly inanimate, passive spectators will become animate 'subjects', interacting with us and other objects in intimate and highly personalized relationships. The task of design is to ensure that these relationships are as enriching and as fulfilling as possible for the people served by these 'objects-become-subjects'.

Enhancing cultural relationships

Relationships lie at the heart of human culture, but their preferred forms vary. Understanding what kinds of relationships people around the world will value requires careful study, not only of cultural needs and patterns, but also of aesthetic and other communicative codes. What functions will people want embedded in their environment, and what functions will they keep →

Stefano Marzano, CEO Philips Design

on display? Functions prized in one culture may be felt irrelevant in another. What objects should 'host' the new intelligent systems? Obvious candidates in one culture may be quite inappropriate in another. And what form should such objects take?

A look in a furniture shop abroad is enough to remind us that aesthetics is often as much a matter of cultural preference as of individual preference. We also need to consider

which materials these new 'hosts' should be made of. Although these objects may look traditional, their new functions may require them to be made of new materials, whose appearance must nonetheless be culturally acceptable.

But more important than appearance or materials is the issue of how the new objects will behave in relation to us and each other, and what communicative codes they will need to use. Unlike humans, these objects will not 'grow up' gradually. They will be expected, like a butler, to arrive fully trained (although allowed a little time to get to know their specific 'masters'). So we will need to 'educate' our new objects.
To do that, we need to know what sorts of behaviour different cultures prefer, and what individual preferences the objects could expect to encounter. The behaviour of our objects as they dynamically interact with users will need to be designed just as much as their technology and appearance.
Intelligence without culture and culture without intelligence – both are equally undesirable. By exploring people's cultural expectations with respect to functions, forms and behaviour, we can ensure that Ambient Intelligence really does improve people's quality of life experience, respecting and enhancing their cultural identity and creating a balanced environment in which they feel both psychologically and physically 'at home'. ←

HOMELAB - advanced feasibility research lab

Evert van Loenen and Vic Teeven

New system concepts

HomeLab has been designed to allow studies of novel system concepts, which today may still require a lot of equipment to realize, but which can be expected to become compact enough to disappear in the background in the near future. It allows studies of distributed home networking systems which require connecting different rooms and floors as found in a real-home environment. By prototyping such systems in HomeLab, researchers can discover and solve the issues that emerge in such actual use environments.

Situational awareness

Ambient Intelligence systems are envisioned to be supportive, because they are aware of the users, and can adapt to their habits and wishes. Therefore, such systems need to include methods to discover the identity and location of users, devices and objects.
Research projects are ongoing to develop optimal technologies, e.g. by investigating the behaviour of radio waves and ultrasound waves in an actual home environment, where furniture and moving people cause a much more complex reflection and transmission behaviour than in an outdoor environment.

Natural interaction

Speech is often considered one of the most natural modalities for interaction between users and ambient systems. Thus far, however, improvement of recognition rates in natural language dialogues, and even in the more limited command and control →

interactions, is hampered by echos and background noise in real environments, forcing users to wear microphones close to their mouths. Novel technologies are being developed to solve these problems, and HomeLab allows such solutions to be tested in a real-home environment. Similar problems are encountered when introducing other modalities, like gesture recognition. Gesture recognition is typically realized using video image processing. Again, whereas nice

examples can be demonstrated in special rooms with well controlled light conditions, gesture recognition in a real-home environment, where doors open and close, people walk around, reflections occur from shiny surfaces and light conditions change continuously, requires the development of more fundamental solutions.

Mobile assistants

Mastering speech and gesture recognition allows studies into exciting further user interaction concepts, such as mobile, robotic personal assistants. These studies are also conducted in HomeLab. HomeLab provides the actual conditions that such mobile assistants have to be able to cope with, like staircases, multiple rooms and families with children.

Connectivity

The Ambient Intelligence systems aim at providing users with the freedom to choose what kind of information or entertainment they want when and where, e.g. on portable screens they can take with them as they move through the house. This means that such systems typically rely on ad-hoc wireless networking of devices. Depending on the type of device (mobile phone, PDA, portable PC, webtablet) and content (photos, films, messages), an appropriate wireless connection is applied, e.g. WLAN (802.11b or 802.11a) for large bandwidth, and Bluetooth or Zigbee for ultra-low power.

Optimal systems will likely consist of a combination of such technologies, most of which operate in the same frequency band. HomeLab offers a realistic environment to test effects like mutual interference and the influence of walls and ceilings, and to study, for example, security mechanisms and bridging of networks in home.

Ubiquitous sound and vision

The key output modalities needed are sound (music, speech) and vision (images). Whereas today the latter is typically concentrated in one TV screen in the living room, future homes will have display solutions in any space where that is appropriate (kitchen, bedroom, etc.). They will range from small displays for messages to full-wall-sized displays for movies. Entirely new technologies will be required to realize such visions in actual home situations, e.g. where people do not have the room required for existing back-projection solutions, or the money for current large-flat-display technologies. Again, HomeLab offers Philips the opportunity to already create the experiences today that such future technologies will bring tomorrow.

Separating functions from boxes

Once the information is fully digital, and ubiquitous connectivity has been realized, it becomes possible to separate the functions actually desired by users (images, sounds) from the boxes that are needed to produce them, thus providing users with a much greater freedom. Users can, for example, choose to place the TV tuners or PCs out of the field of view, and eventually to let them disappear in the background. Many issues emerge when trying to realize such solutions in real-life circumstances, and HomeLab is a rather unique environment for learning how to solve them: in its 'user spaces' it provides all the actual elements found in a real house (e.g. walls blocking the infrared remote control), whereas through its 'research spaces' ambient solutions that require further miniaturization before they can be made ambient, can already be realized today.

Feasibility research

In the months up to the opening, HomeLab has already proven to be a valuable tool to study and demonstrate the feasibility of the novel system concepts developed in several Research projects, and to collect the feedback of visitors and users. Many more projects will populate HomeLab in the coming years. ←

HOMELAB - technology for people

Berry Eggen, Boris de Ruyter and Vic Teeven

Multi-disciplinary approaches

Advanced technology is readily advertised to enhance the quality of future home life. For example, the introduction of network technology in the home is said to reduce the functional redundancy found in current homes and increase efficiency and ease of use to save time do the things one really wants to do (quality time). But, how are future electronic products going to use these networks to achieve the anticipated user benefits, and what user-system interaction knowledge is required to realize a true paradigm shift from 'operating devices' to enhanced and new 'interactive experiences'? To find answers to these questions we need to study the physical, social and cultural context in which technology will be used and its implications on daily life. HomeLab offers a unique environment that is optimized to conduct research in these areas. Multi-disciplinary teams of researchers together with potential end-users explore the advantages and disadvantages of prototypes of future electronic systems in a realistic home setting.

User-centred research

Nowadays, the technological possibilities to enhance home life are vast; to quote the prototypical engineer, "tell us what you want and we can make it". But, what do people really want? Once we better understand the needs and desires of people, the output of a structured idea generation process is expected to yield product or system concepts that show an increased potential to truly enhance living and being at home. Of course, such claims should be validated by evaluating the anticipated user benefits before a selection is made to bring certain concepts into a second research and design cycle. In a next iteration cycle, more detailed user requirements need to be uncovered and fed into the generation and implementation of concrete design solutions. Next, the utility and usability of the proposed solutions can be checked by conducting carefully planned user tests. This iterative process which is carried out by multi-disciplinary teams and in which user involvement plays a crucial role is called user-centred research. HomeLab is designed to become the place where researchers and designers can team up with end-users to realize a shared and tangible vision of the future of in-home electronic systems.

User involvement

Although HomeLab provides a fully-functioning home environment where people could live for a longer period of time, it is expected that people, initially, only participate in interactive HomeLab sessions that typically only last a couple of hours. During these sessions, researchers can directly interact with the participants and the systems under investigation, or people can explore the Ambient Intelligence environment on their own while unobtrusively being observed by researchers that make use of the HomeLab observation facilities.

HomeLab is well equipped to support both types of user behaviour research. The interior decoration and the possibilities to flexibly re-arrange or move furniture around the house makes it easy to adapt the house to match the particular lifestyle of intended target groups, making the 'inhabitants' of HomeLab feel safe, happy, at ease, and stimulated. HomeLab has two observation rooms which in combination with 34 cameras, distributed over the house and controlled by the HomeLab control system, provide the right infrastructure for doing observational user studies. The type of user studies that can be facilitated ranges from observations of user (and system) behaviour to 'traditional' usability tests. Below some imaginary examples are described.

Wizard-of-Oz

Bob and Linda have been invited to HomeLab to experience how a future living room might support the planning of their yearly summer holiday. After a tour around HomeLab, which surprisingly well matched →

the picture of what they would consider an 'ordinary' home, they settle at the dinner table and start to browse the holiday brochures lying around. After a while, they begin to realize that the room seems to listen to their conversations, as pictures and movie clips started to appear on the wall that matches the actual holiday destinations they are discussing. Things get even more interesting when the colour of the lighting of the environment adjusts to the Tuscany pictures they are looking at. The experience is complete when they notice the soft Italian music that was playing in the background.

After Bob and Linda selected their dream holiday, they join the research team to discuss the way they experienced the Ambient Intelligence room. They both tell the team they are impressed by the smartness of the room and the smooth way interesting media were displayed in the room only when it seemed appropriate and meaningful. At the end of their visit to HomeLab, Bob and Linda are given a tour backstage.

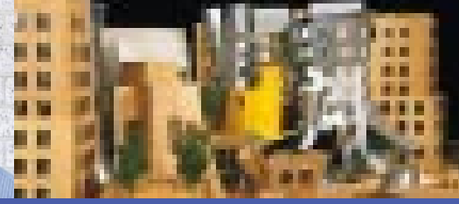
This is where they learn about the Wizard-of-Oz type of experiment in which they had been involved. It turned out that the intelligent behaviour of the room was not generated by an electronic system but by a group of researchers who had been watching, listening and interpreting their activities to select, present and direct the actual media interaction experience in which Bob and Linda had been immersed. After some initial disappointment that the system was not yet for sale, their enthousiasm returns: Bob and Linda would love to live in the Ambient Intelligence environment they had been experiencing at HomeLab.

Usability testing

Boris has settled on the couch in the HomeLab living room. Jettie, the test leader has instructed him to compile an mp3 playlist from the huge music collection present in the HomeLab jukebox. He quickly selects his top 5 by just telling his display the song titles. Now, he tries to remember that song he liked so much last friday at Judy's. He doesn't know the exact title, so, for the first time, he tries to hum its melody. It works just like Jettie explained to him. After some time Boris decides he is done and satisfied with his playlist. While Boris was completing the music compilation task, Steffen has been using the HomeLab control system to score the various actions Boris needed to carry out to complete the task. After the experiment, Steffen can immediately inform Jettie about the number of times Boris used the query-by-humming functionality as compared to the spoken-commands option. He even can show Jettie an 'on-the-fly' compilation of video sequences of situations where Boris explicitely formulated his enthousiasm for the humming feature.

Social interactions

The Jones family has tremendously enjoyed their stay at HomeLab. Over the weekend, they have gotten a glimpse what living in the future could be like. Now they are discussing with the Philips Research crew how they think Bello, the virtual HomeLab pet, could do even better in anticipating and serving their saturday night entertainment needs. Actually, Kevin, the 12-year old son, says he does not like the way Bello seems to favour his Dad when it comes to fetching music programmes they both should like. By reviewing the video material that was captured over the weekend, Dad and Elmo, the project leader from Philips Research, have to admit that Kevin has a point here. Together, the three of them are able to spot similar examples of Bello's behavour in the video material and after a good discussion they decide that it seems an important design guideline for any future Ambient Intelligence system not to take position in social interactions among family members. ←



The Oxygen Partnership Alliance

Rodney Brooks, Director of the Artificial Intelligence Laboratory and Professor of Computer Science and Engineering of the Massachusetts Institute of Technology

The Oxygen project aims to create a system that brings abundant computation and communication, as pervasive as free air, naturally into people's lives. Intelligent spaces, like the Artificial Intelligent Laboratory's Intelligent Room, will serve its occupants as transparant points of interaction. In the Intelligent Room, robotics and vision technology are combined with speech-understanding systems and agent-based architectures to provide ready at hand computation and information services for people engaged in day-to-day activities, both on their own and in conjunction with others.

Rodney Brooks: "Only through living with our technologies can we discover which ones really improve our lives and which ones only sound good as proposals."

Members of the Oxygen Partnership Alliance include Acer Group, Delta Electronics, Hewlett-Packard, Nokia, NTT and Philips.

HOMELAB - behind the scenes

Vic Teeven and Berry Eggen

The Home

Standing in front of one of the new buildings at the Philips High Tech Campus, you will notice a part that clearly differs from the rest. It has a front door in glass, signed with the letters 'HomeLab', it is built in a different style and has a different appearance. Going through the front door you will discover something that you would not expect: you enter the hall of a normal house. It is a completely furnished environment, including the objects found in real homes. Families can stay here, even for a longer period of time, and interact with concept demonstrators of future in-home electronic systems developed by researchers and designers. The two-stock house has a living, a kitchen, two bedrooms, a bathroom and a study. Interior decorators have created an atmosphere that matches a modern one-family home as closely as possible. At a first glance, the home does not show anything special, but a closer look reveals the black domes at the ceilings that are hiding cameras and microphones. These cameras and microphones form an integral part of the house and are designed to quickly disappear in the background of people's mind.

The Lab

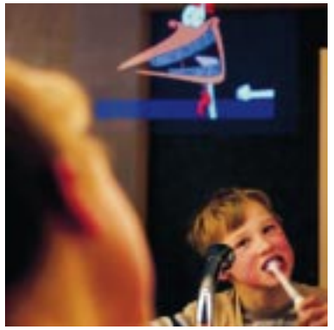
Adjacent to the Home, and separated by one-way mirrors, there are two observation rooms. From the main observation room you have a direct view into the living. Additionally, the signals captured by the cameras, can be monitored on any of the 20 video screens that are available in the observation room. Another, smaller, observation room is located at the second floor of HomeLab. Through one-way mirrors it gives a direct view into the bathroom. It can be used to observe people during shaving, hear drying or tooth brushing. Alternatively, the one-way mirrors in the bathroom can also be used as 'smart mirrors', for example to show the actual news, the traffic situation, or your weight.

Studying human behaviour

The possibility to observe participants during their stay in HomeLab is one of its primary functions. A tailor-made HomeLab control system has been developed in-house to collect and analyse observational data. The system controls the cameras and the routing of the video and audio signals. Human activities, postures, facial expressions, social interactions and user-system interactions can be recorded and digitally stored to study patterns, trends and relationships. Results will be used to improve products, to eliminate imperfections and to explore new applications.

The main observation room offers a place for an observation leader and four observers. The observation leader is responsible for the data collection and will be the director of the HomeLab interactive session.

The observation leader modifies camera setups, routes video and audio signals, and monitors the capture stations. The main task for an observer is to concentrate on monitoring the behaviour of the participants. This can be done by looking directly into the home through a one-way mirror, or by viewing a video monitor that can be connected to any of the 34 cameras in the house. The behaviour of a participant is 'scored' in terms of events that characterize the observed scene. The scored events are time-stamped and appended to the video data. In this way, the HomeLab control system both implements an accurate and efficient support tool for doing observations and facilitates a flexible system for exploration and analysis of the acquired data.



Technical infrastructure

HomeLab has more to offer. Broadband Internet facilities enable various ways to connect parts of the HomeLab infrastructure to the Philips High Tech Campus network or even to the outside world. A wireless Local-Area Network (LAN) offers the

EU research efforts in Ambient Intelligence

Erkki Liikanen, Member of the European Commission for Enterprise and Information Society

The world of Ambient Intelligence will, gradually but surely, emerge from research in the Information Society Technologies (IST) programme of the European Community.
It puts people at the centre of the development of future IST, i.e. 'design technologies for people and not make people adapt to technologies'. It aims at making technology invisible, embedded in our natural surrounding and present whenever we need it (e.g. electricity) and at making interaction with the technology simple, effortless and using all our senses.

Erkki Liikanen: "HomeLab is an excellent example of a natural surrounding where normal 'man and woman on the street' can join members of the research community, from industry and academia, to pull together their effort and build coherent approaches to realize the Ambient Intelligence vision."

possibility to connect people in HomeLab without running cables. However, if cables are required, double floors provide nice hiding places. Corridors, adjacent to the rooms in HomeLab, accommodate the equipment that researchers and developers need to realize and control their systems and to process and render audio and video signals for the large flat screens in HomeLab. A power control system features remote controllable light settings and power switches.

But it still leaves the possibility for participants to simply turn on and off the lights by using 'ordinary' switches. Future intelligent systems that aim to enhance people's emotions and experiences by means of lighting will be able to interface with the HomeLab power control system. ←

In good company

HomeLab offers a unique environment, both physically and intellectually, for researchers and their partners inside and outside Philips to give concrete form to the Ambient Intelligence vision. By developing and integrating advanced technologies in the areas of display, storage, signal processing and conncectivity, HomeLab promises to become one of the true corner-stones of Ambient Intelligence, where people can experience in reality how future technology will enhance their living and being at home.

Currently, a number of companies and academic institutions are active in conducting research into pervasive, human-centred computing. Some of them have joined part of their research efforts in strategic alliances like the MIT Oxygen Partnership Alliance, of which Philips is a founding member together with Acer Group, Delta Electronics, Hewlett-Packard, NTT and Nokia. Others like Intel, Motorola, Mitsubishi, Procter and Gamble, LEGO and Royal Ahold, are sponsoring related research projects at renowned universities.

Philips is also an active member of two European initiatives in the field of Ambient Intelligence. As a member of the ISTAG (Information Society Technologies Advisory Group) it is helping to advise the European Commission on the role of Ambient Intelligence within Europe's 6th Framework Programme (FP6). And as part of the ITEA (Information Technology for European Advancement) AMBIENCE project it is helping to define the architectures, methods and tools required in the development of 'context-aware' ambient intelligence environments.

INRIA, Philips, and Thomson Multimedia, identified the opportunity of joining forces in the field of the Ambient Intelligence technologies and establish a stable structure that allows long-term research issues to be addressed in a satisfactory manner for all the parties involved. It was agreed to launch a Joint Research Initiative under the name AIR&D (Ambient Intelligence Research and Development) in which the parties involved collaborate on a project basis.

Some companies and universities have come to realize that their visions on the future of computing and consumer electronics can only be explored to their full potential when along the way results of their research and development efforts are integrated and tested in a real environment and evaluated with real people under real-life conditions. Philips is one of these companies and HomeLab is the first tangible example within Philips of this notion. Other examples are described in the following pages. ←

IN GOOD COMPANY -
Georgia Tech Aware Home

Gregory Abowd, Director of the Aware Home Research Initiative and Associate Professor in Georgia Tech's College of Computing

The Aware Home of Georgia Institute of Technology serves as a living laboratory for research in ubiquitous computing for everyday activities. The goal is to develop the requisite technologies to create a home environment that can both perceive and assists its occupants. The scope of the projects carried out at the Aware Home ranges from fundamental technical development to cognitive and ethnological studies that assess the most appropriate and compelling technological strategies.

Gregory Abowd: "Building a living laboratory to investigate the impact of ubiquitous technologies in the home is critical for the understanding of how technology impacts our domestic life. It not only allows us to investigate feasibility but also provides insights into the desirability of the augmented home life. And for an advancing population, the investigation of technologies for successful ageing are paramount."

Aware Home is sponsored by Intel Research, Motorola Labs, Hewlett-Packard and Visteon Corporation. ←

IN GOOD COMPANY -
MIT House_*n*

Kent Larson, Director of the Changing Places Lab: a Joint MIT Media Laboratory and Department of Architecture Consortium

House_*n* is a multi-disciplinary consortium of researchers and companies that have come together to reconsider the home: how it is designed, how it is built, and how new systems, services and technologies can prepare our places of living to better meet the challenges and opportunities of the future.

A single-family prototype house has been designed for an MIT-owned lot in Cambridge, Massachusetts. The facility will be used to evaluate design and digital/physical infrastructure concepts and to accommodate ongoing research as a 'Living Lab'. The Living Lab is designed to allow long-term, scientific studies of occupants and their relationships to their environment and the technology of the home. Kent Larson: "Responsive technologies may profoundly alter the places that people inhabit, but we have not yet found answers to the central question: How can complex and ever-changing systems be made accessible and useful in the context of the highly varied and continuously evolving activities that take place in the home? My hope is that the Philips HomeLab and the MIT Changing Places Lab will become key components of an international community of research facilities to develop and test new technologies in the context of life."

House_*n* Consortium members include International Paper (Building Materials Group), Owens Corning, Salt River Project, State Farm Insurance, Procter and Gamble, Bentley Systems Inc., and Invensys. ←

IN GOOD COMPANY - Microsoft Concept Home

Craig Mundie, Senior Vice-President of Consumer Strategy, Microsoft

The Microsoft Home is a prototype home located at Microsoft's main Redmond campus. This concept family home is designed to present the company's vision of better living through technology as that technology becomes more personal and useful. The home brings together new scenarios and technologies to make daily life easier, safer, and more fun for all family members. The original Microsoft Home opened in 1994.

Craig Mundie: "Microsoft congratulates Philips on the opening of their HomeLab. We are excited to see their commitment to researching and prototyping technologies to enhance consumer experiences." ←

LE POÈME ELECTRONIQUE - the first immersive media experience

André Meyer

The Philips Pavilion

At the World Fair in Brussels in 1958, Philips demonstrated its technology and vision in a special Philips Pavilion. Nearly two million visitors experienced a media show, totally different from a typical display of consumer products. What they saw, was a dazzling demonstration of cutting-edge technology in the service of the arts. Philips presented a fully automated, 480-second programme of colour, voice, sound and images that was broadcast within a space of warped concrete shells. The building was initiated by Philips' artistic director L.C. Kalff and designed by Le Corbusier and Yannis Xenakis to set an exceptional stage for the first immersive media experience: *Le Poème Electronique*. In the scenario of *Le Poème Electronique*, Le Corbusier brought together the music composed by Edgar Varèse with a series of images illustrating evolution from the dawn of humanity to the atomic age, not without some critical remarks, and a plenty of visual and sound effects fitted into the extraordinary architecture.

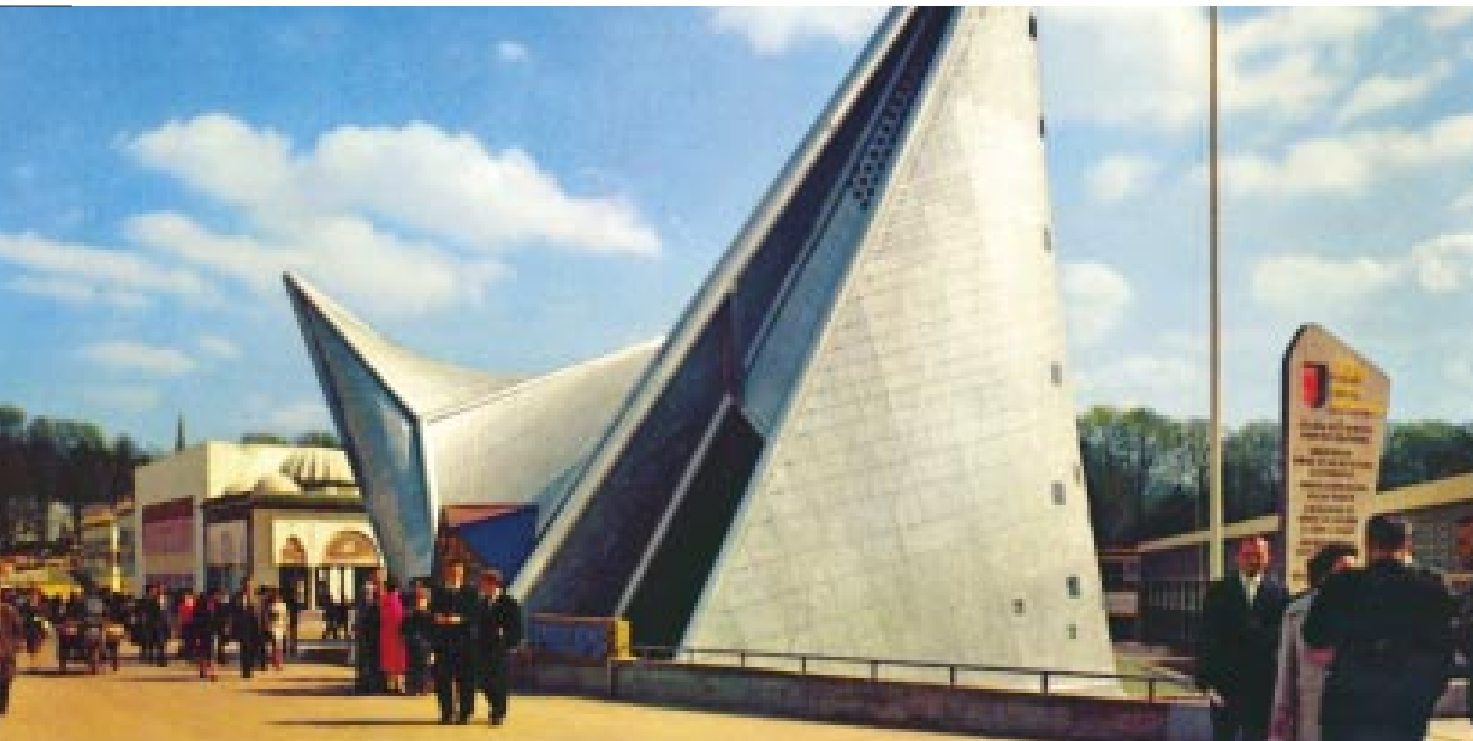
The Philips Pavilion aimed to make a statement about the harmony between human values and technology, a central theme of Le Corbusier. The structure consisted of a mathematical figure combined with a human form: a shell structure of hyperbolic paraboloids rose above a floor plan in the shape of a human stomach.

An experience was created with stochastic music and sound effects *(musique concrète)* that would not have been recognized as →

music at the time. Projected images were modified and enhanced with coloured light that supported the flow through the building, an early example of liquid architecture. *Le Poème Electronique* reminded visitors of a musée imaginaire with its collection of references to all sorts of global cultures.

A seminal experience

Marc Treib, professor at the Department of Architecture (University of California), studied the Philips Pavilion and brought it back to life in his visually compelling book called 'Space Calculated in Seconds: The Philips Pavilion, Le Corbusier, Edgard Varèse' (1996, Princeton University Press). In his opinion, the Philips Pavilion should be seen as a landmark multimedia production: "… the Philips project […] can be viewed as a pioneering quest into the production of modern art, or even as a prototype of virtual reality." Athough the pavilion was dismantled after the World Fair, the memory of this fascinating project, this important achievement in the history of Philips and this pioneering attempt to harmonize innovative technology with people's values is kept alive. ←



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