

AmbiComp

Ambient Computing



AmbiComp is a research project running from 2006 to 2009 that is funded by the German Ministry of Education and Research (Bundesministerium für Bildung und Forschung). The research topic is the question of how a lot of small and very small computers can be programmed in such a way that they can reach a common target, respectively solve a common task. Furthermore, the research project shall design small computing components to transform our daily environment into an intelligent one.

AmbiComp is open for associate partners, especially small and medium-sized enterprises that want to offer their customers innovative products and solutions based on embedded and networked control.



Features

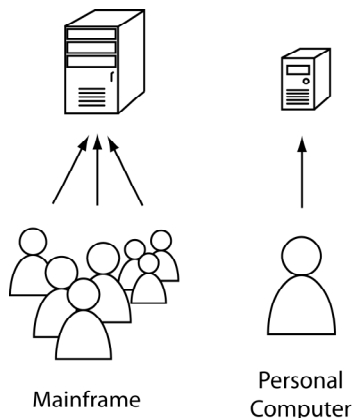
- Ambient Intelligence Control Units (AICU) based on powerful microcontrollers
- Embedded operating system
- Compact Java Virtual Machine (JVM)
- Intelligent routing for distributed processing (SSR)
- I/O modules for different applications and interfaces:
 - Ethernet (IEEE 802.3)
 - Bluetooth (IEEE 802.15.1)
 - Low rate WPAN (IEEE 802.15.4)
 - Serial interfaces (RS232 & I2C)
 - Plain I/O ports
 - Power supply
- Development environment to support the development of applications based on "Eclipse" together with an AmbiComp-specific plug-in

* Bluetooth is registered trademark of Bluetooth SIG, Inc., Bellevue, Washington.

** I2C is registered trademark of NXP Semiconductors, Netherlands B.V.

Ambient Intelligence

Ambient Intelligence is a vision that encompasses a multitude of embedded systems enhancing our daily living and working environments with computing power and communication abilities in such a way that the embedded systems, together with connected sensors and actors, solve a common task. The individual computer takes a back seat; instead, the whole



environment is perceived as being intelligent.

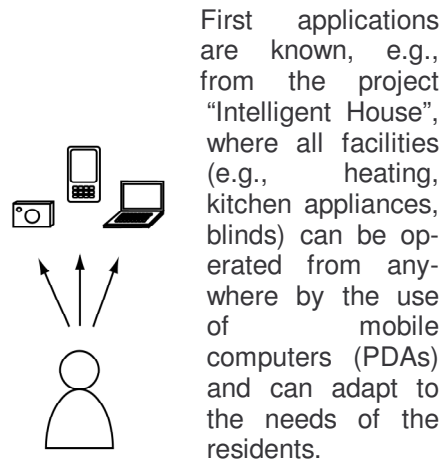
The applications of such a system are intended to noticeably improve daily life and shall be applicable in many areas.

It is important that such a system can be used and operated without major training effort - the system shall autonomously detect the needs of the users and react accordingly.

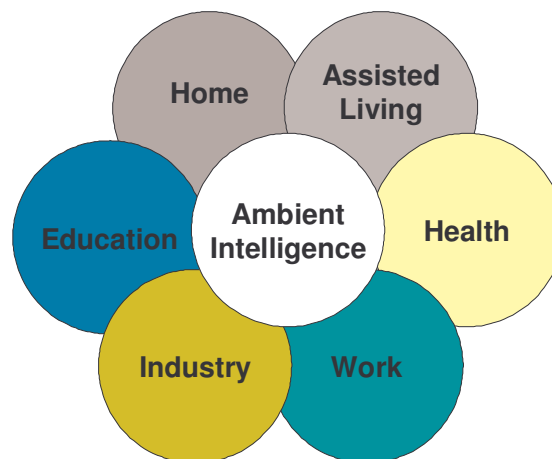
To give an example: A building can detect that its residents are on a trip over the weekend by observing their activities and then act accordingly by turning down the heating. Furthermore, the indoor plants can be protected from direct sunlight by

closing the blinds, and the TV can block certain programs if no adult is present.

Such systems can take over a lot of control tasks. However, the advantages for the user (e.g., fire alarm, traffic flow control) have to be balanced against the resulting disadvantages (e.g., control, lack of privacy).



So far, European research on Ambient Intelligence has focused mainly on the development of architectures and applications, and less on the corre-



sponding technology.

AmbiComp

AmbiComps aims at just this sector, by developing the necessary technology, with emphasis on a development environment that shall allow an inexperienced programmer to develop such distributed applications.

The goal of the project is to simplify the development of software for embedded systems in the area of "Ambient Intelligence". Especially small and medium-sized enterprises shall be enabled to develop and market such equipment together with the necessary software and assure its interoperability with products of other vendors. In addition, it shall be easily possible to integrate open-source software into products of other vendors without affecting the functionality, stability, and security of these products.

AmbiComp is developing a software development platform based on the Java tool Eclipse.

This facilitates the development, testing, and distribution even of ambitious Ambient Intelligence applications.

Furthermore, embedded controllers will also be developed in the context of the AmbiComp project that can be integrated into various products in order to equip them with Ambient Intelligence.

Modules

The innovative basis of the project lies in the concept of combining small and very small components into a system. This substrate, which will be called *Ambient Intelligence Control Units* (AICU) in the following, comprises hardware (microcontroller plus external wiring) that can be embedded into Ambient Intelligence products as well as the software that resides firmly inside the microcontroller (the so-called firmware).

The firmware acts as a kind of minimal operating system. Besides the drivers for the hardware, it also provides a Java

execution environment as well as other parts, e.g. the communication protocols.

The goal is to provide fully functional AICUs that can be programmed with tools also developed during the course of the project.

The basis for the use of the AICUs in real devices is the possibility for the application to access the sensors and actors of the respective device. From the application point of view, this interface has to be platform-independent.

A set of such device interfaces is provided in the form of so-called

sandwich modules. These include:

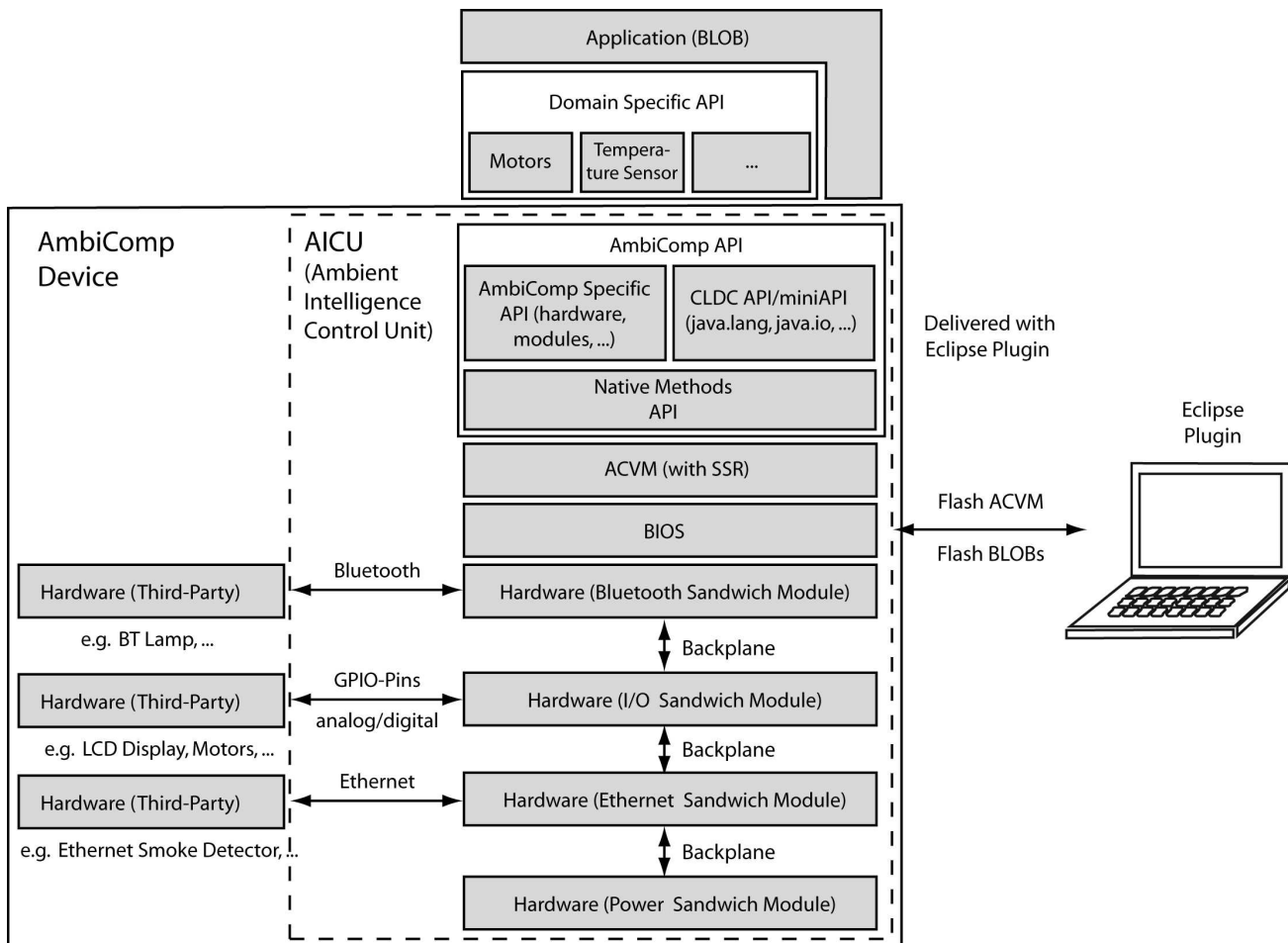
Bluetooth Sandwich Module with a Bluetooth 2.0 interface.

Low Rate WPAN Sandwich Module with a power-saving low-reach radio interface (according to IEEE 802.15.4).

Ethernet Sandwich Module with a 10 Mbit/s Ethernet interface.

I/O Sandwich Module with a set of simple I/O ports, where additional periphery devices can be connected.

All modules contain their own intelligence and are able to communicate with each other.



Communication

The basis for the communication of the AICUs with each other is the intelligent, self-organized routing protocol *Scalable Source Routing* (SSR). It allows addressing the devices in the network in a large but flat address space. The self-organizing character of SSR allows linking the participating devices without prior complex planning of a network topology and without any configuration effort.

Further, SSR has only a very limited memory requirement for

storing the routing status when forwarding messages.

With this kind of communication, the classic solutions known from distributed systems can be transferred to the area of Ambient Intelligence. Especially SSR allows programming the multitude of small devices as one comprehensive system.

Development Support

Together with the software engineering methodology, a development environment based on the open-source tool "Eclipse"

was created. Using this environment, even developers in small companies can quickly and productively work with a well-known tool.

This development environment allows fast development and testing of an Ambient Intelligence application when the distributed system consisting of many modules is not visible.