# New Clothes for Robot Albert

*Michael Zwölfer, Volker Koch*

*ifib, Institut für industrielle Bauproduktion, Prof. Dr. Niklaus Kohler, Universität Karlsruhe (TH), Germany*

*http://www.ifib.uni-karlsruhe.de*

*The projects 'I, Robot', 'New Clothes for Robot Albert' and 'Robots House' are three examples of design projects at the institute for industrial building production (ifib) that illustrate the same didactical approach for the training of students.*

*The common principle is characterised by the confrontation of students of architecture with a kind of task, that almost is not related to architecture and that seems rather strange at the first glance. The background of the task allways has a strong technical regard and is defined by other departments.*

*So already the understanding requires an exchange with some experts of these departments and the solution even a close cooperation with them. In most cases the partners are from the field of mechanical engineering or computer science.*

*The common theme in these three projects is robotics, a forward-looking discipline especially interesting because of its wide complexity as well beyond a purely technical comprehension.*

*In the Project 'I, Robot' multidisciplinary teams of students used the Not Quite C developer kit and the Lego Mindstorm Robotics system to develop robots for an indoor rally. This project is repeated annualy at ifib and at RWTH Aachen.*

*In the Project 'New Clothes for Robot Albert' students of architecture designed and produced a spacial structure and cover for an existing and running humanoid service robot. This robot was developed by the Institute for Industrial Applications of Informatics and Microsystems (IAIM) of Prof. Dr. Dillmann for experimental purposes regarding learning strategies for service robots.*

*In the Project 'Robots House' finaly students of the university cooperate with students of the university of applied science to find a concernment of architecture by today's and future robots. The background is the demand for service robots in homes of handicapped or elder people triggered by the demographic changes; the approach is to consider today's service robots as well as handicapped in a certain manner. The project is accompanied by the expert for handicapped accessible planning, Prof. Dr. Loeschcke and by scientists of the IAIM around Dr. Markus Ehrenmann.*

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## 1.Projects

### 1.1. I, Robot

This was the initial project dealing with robotics at the ifib started in 1998. At the same time it was the furthermost project from the established architectural notion. The link between this project and architecture was purely reduced to the aspects of interdisciplinarity.

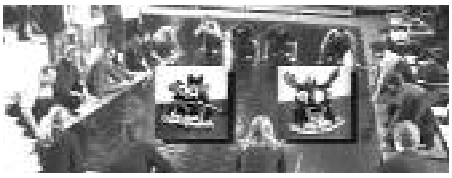

Figure 1. Preparing the final 'I, Robot' Racing.

Teams of students from different faculties had to design, to build and to programm a robot that had to execute a set of actions in a competitive atmosphere. The students accomplished this task with the Legoe Mindstorms robotic system in conjunction with the programming language Not Quite C.

As the project already was presented at eCAADe 2002 [Russell], it will not be discussed in detail here in the context of the serie of projects dealing with robotics.

### 1.2. New clothes for robot Albert

In this project the exotic aspect consisted in designing a cover for an unusual object, a robot. Procedure and the necessary skills were almoast classical to architecture. But in detail there were some exciting differences. The role of interdisciplinarity in this project was limited to the general approach and understanding of the problem.

Albert is a humanoid service robot, that was built by the IAIM at the university of Karlsruhe for the experimental development of learning strategies. A characteristicum of Albert is, that it should learn simple home services (e.g. setting up a table) directly by imitating its human master. For imaging and cognition Albert has a head with two cameras, that gives it a humanoid touch. The main motoric parts of Albert are one single arm composed of seven joints, a very crude looking hand with three fingers and an industrial wheel-based platform for displacement.

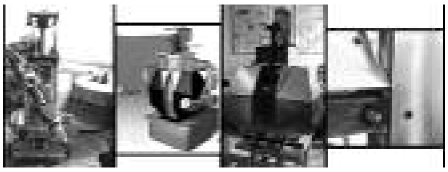

Figure 2. Service robot Albert and the clothes.

Albert is composed of standard industrial parts, that are responsible for its oversize and gorilla-like proportions. The experimental character of Albert imposed a very flexible cover with good accessibility of all technical components.

The students had to design a spacial structure and cover for this robot. This is primarily a question of product desing. The challenge is to meet an adequate design that inspires confidence trough a friendly appearance and at the same time does not raise too high expectations concerning the skills of the robot, which would cause a severe disappointment. The risc of overshooting is an aspect also well known in architectural design but it is not discussed on such an explicit functional level.

In a first step the students made a design study to meet these requirements. Then the results were discussed together with representatives of the IAIM. All results were highly individual and equivalent. So the integration of all advantages to a new draft was considered as the best solution.

The draft had to be detailed for realisation in the following step. It seemed to be impossible to use usual CAAD tools for architects, because of the disability to describe kinematic spaces. From mechanical engineers at the IAIM the students learnt a way to freeze all kinematic states of the robots arm into a single 3D-solid, that then could be inserted into a conventional CAAD-drawing.

The general setup of this project was to first develop a primary structure using steel tubes and then to elaborate a secondary structure to form an exactly fitting cover. This procedure corresponds to construction practise (core and shell) and is responsible for some major phenomena, e.g. the risc of large gaps between planning and execution respective the divergency of costs. The students experienced that problems they didn't solve within the core planning phase, 'stroke back' on a significantly higher level at the shell planning phase.

### 1.3. Robots House

This project was the one with the most ostensible relation to architectural problems.

The role of interdisciplinarity here was to define aspects relevant for design through an integration of foreign contents in close accompaniment of experts.

The project was a cooperation between high-

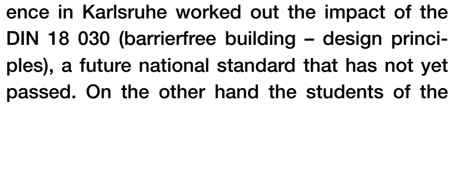

*Figure 3. Beginning intersection of the humans' and the robots' world .*

scools with the goal to find new patterns for obstacle free planning in general. On the one hand the students of the university of applied science in Karlsruhe worked out the impact of the DIN 18 030 (barrierfree building – design principles), a future national standard that has not yet passed. On the other hand the students of the university in Karlsruhe worked out the impact of today's and future robotic on architecture.

The first step was to elaborate a clearer idea of robotics; to destinguish industrial robots with their typically capsulated surrounding from the service robots that not only interact with humans but even with technically unaware people. The students had also to get a feeling for the permanent flux in robotics and the resulting contradictory impact for architecture: service robots of today are not quite powerful respective useful and their great lacks require much respect in planning, which is very similar to the planning for handicapped people. Future robots are expected to provide a high performance and to be useful; however, due to their perfect humanoid platforms, there won't be any need to take them into account for planning.

In this dilemma some students decided to develop a scenario optimized for a concrete existing service robot. They procured all aspects and technical data concerning the robot and developed from this a scenario in close contact with the producer of the robot. As intermediate service robots compensate their im-perfection with enduring activity this lead to interesting temporal dependencies.

Other students decided to focus on a specific technical deficit of the mashines today. Starting from a very detailed aspect they developed scenarios for a tolerable coexistence of both humans and mashines. E.g. the cognitive skills of today's robots require rather crude dessins for the surfaces in order to make objects distinguishable. By systematically zoning rooms in areas for human perception and areas for the robots' perception they got astonishing results.

The results of this project were general planning patterns for the integration of temporal and spacial aspects of robotics in architecture. It was the highly systematic approach, triggered by the need of classification an apparently orderless foreign field, that augmented the student's awareness for the architectural problems.

## 2. Results

The excessive demands in the projects have several instructive effects and lead to a gain of awareness also for appropriate architectural design.

Trough the pressure of unfitting tools the students investigate different ways to accomplish their tasks. They better exploit their usual ressources by developing workarounds. They adapt problem solving strategies from other engineeers.

Through comparison and the search of analogies between the strange and the familiar world the students get closer to the strange context and at the same time they reflect the known areas. Herein they are supported by an interdisciplinary discussion between the representatives of architecture and the other disciplines. The didactical profit lies in the appropriation of new points of view.

Through a series of compromises the procedure leads to a certain reduction of complexity in the requirements. However this requires intensive negotiations with the teachers and so the procedure resembles a distillation in which only the attainable and substantial part of the task finally remains. The didactical profit lies in the ability of handling compromises.

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