



## COVER SHEET

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# Building *Smarty*: A Low Cost Robotics Kit for Queensland Secondary Schools

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Robotics is an area with enormous potential for education. It addresses computing, engineering, science and mathematics in exciting concrete ways and allows for genuine collaborative problem-solving experiences for students of all ages. There are a number of proprietary robotics kits available commercially and while these are attractive, they are also generally quite expensive.

A development project has begun within the Faculty of Information Technology, QUT with support from the Faculty of Engineering and the Faculty of Education, QUT to develop a low cost robotics kit for Queensland Secondary Schools. If funding becomes available, technical and curricular support will complement the development and trialling of the robotics kit. The project is very much a prototype and in the early stages of development.

The robot being developed provides two main areas of student engagement – the first is in the design and building of the robot itself using a range of component parts, while the second is in the programming of commands. Current *Smarty* programs are written with interactive C (freeware) and trials are being conducted to consider the use of C-Net. The robot will have a wheeled form similar to other commercial packages, but will also be able to support other robotic aspects such as legs and arms, which are not available in other commercial packages..

## **Introducing *Smarty***

The working name for the robot is *Smarty* but this may change by the time any roll-out takes place. Some of you may have seen *Smarty 1.0* and met its developer, Raj Singh from QUT's Faculty of IT at the Share-IT Day, at Ferny Grove SHS (August 12, 2004). While *Smarty* is not particularly elegant or colourful, it has the potential to provide some high-level learning experiences for students at an affordable cost for schools.

The aim of the project is to develop a multi-functional robotics kit comprising of:

- *Smarty 1.0* controller board which can drive motors and process data from sensors
- A set of basic and unassembled electronic components e.g. microprocessor, external interfaces, 16 sensors (both analogue and digital).
- An operating system for the microprocessor
- Sets of instructions for
  - fabricating the robot chassis
  - assembling the complete robot
- A software development environment for building software to control the robot
- Classroom ideas and exemplars

The intention is to provide all of this for as low a cost as possible. The cost may be as low as \$10.00 to \$30.00 per kit and as this comes with reusable components, this will represent real value for schools. The continuance of the project is subject to continued funding within the relevant faculties.

## **Where *Smarty* might fit into the Queensland secondary curriculum**

We are all aware of the use of the Lego Dacta and RoboLab kits used with primary students in Mathematics, Science, Technology or in integrated activities. Where robotics, and more particularly, where a robot like *Smarty* fits into programs for older students is not as evident.

Robotics is well suited to those syllabuses which embed problem-solving, such as the Design-Develop-Evaluate (DDE) of Information Processing and Technology (IPT) and the Investigation-Ideation-Production-Evaluation practice model of the Technology KLA. Because of the fineness of motor skills, deftness in construction and skills in programming needed to get the most of a robot like *Smarty*, its place is obviously in secondary classrooms. Depending on the characteristics and skills of the classes involved, teachers could opt to focus more on one area than another. For example, in Technology KLA students could focus on the building and assembly and use set routines for the programming. Because *Smarty* is effectively a board and basic kit, it can take on a variety of external appearances and students could be asked to make creative use of recycled materials in its construction. Alternately, in IPT, the task could be to program a previously built robot and the student would need to consider what was required to move a robotic arm to complete a given task.

The low cost robotics kit being developed could be of specific use in the following Queensland syllabuses:

### **Technology KLA (2003 Syllabus)**

The whole process of designing, constructing, programming and testing a robot is consonant with the outcomes of the Technology KLA and the concept of “working technologically.” It is a concrete example of where the KLA strands of information, materials and systems are interdependent. The low cost robot kit would be more suitable for secondary students engaged in more complex design challenges. (Level 5 and above).

### **ICTE**

*Information and Communication Technology Education (August 2004)*

Robotics – using any robotics kit – sits comfortably in the *Interfacing with Machines* strand of the ICTE subject area syllabus. An interesting extension activity would be for students to take part in discussion groups related to robotics as part of the *Participating in Online Communities* strand.

### **IPT**

*Information Processing and Technology (2004 Syllabus)*

In the **Software and Systems Engineering (SSE)** topic, students could engage with:

- Operating Systems and Environments
- Algorithm Theory and Design
- Software Programming

There is considerable scope in how this area is taught but attention to procedural design and implementation is mandatory. Designing, constructing, programming and testing a robot would be a concrete demonstration of the software development cycle and form the basis of a minor or major project.

In the **Information and Intelligent Systems (IIS)** topic, students could engage with the theory and concepts of artificial intelligence as well as the application of specialised programming language. The philosophical issues related to the simulation of human attributes and biological systems (such as vision, speech, voice recognition, movement and gesture) could also be investigated.

It would not be difficult to incorporate Human Computer Interface (HCI) and Social and Ethical Issues (SEI) into a study of robotics. Resources for the SEI component would be readily available and given the recent release of the film *i-Robot* should prove a rich ground

for discussion with students. When built collaboratively, it could also allow students to engage with project management processes.

**For more information on this project or to register your interest in being a trial site, contact:**

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If you are interested in being a member of an online community talking about robots in education, please contact the RITE group at [contact@rite.ed.qut.edu.au](mailto:contact@rite.ed.qut.edu.au).