Part C Project Details

11. Needs and Applicant's Capability

(a) background: evaluation of the present situation that leads to the need for this project

This project aims to develop an Internet platform for project-based learning in Design and Innovation. The Internet resources to be developed include (1) an Internet design software which enables secondary students to perform design projects from the components library, (2) a fully-featured design curriculum for project-based self-learning and class-teaching using the Internet resources, (3) a 3-D simulation software for design verification, (4) a 2-D drawing recognition system that converts students' designs in 2-D drawings to 3-D works to facilitate the design process, and (5) an Internet platform for the students to share their design works with others and to take part in an Internet design competition to be organized in this project. The on-line design curriculum will use robots as examples of the design projects.

Using the proposed Internet resources, secondary schools can easily develop their school-based curriculums and enhance their ability in developing technology projects and helping their students improve their experiences and skills in design and innovation. Students in Hong Kong can simply access the Internet resources and explore design and innovation by interactively carrying out various design projects.

The Need

- **Secondary schools and students have strong interests in Design and Technology:** In recent years, local secondary schools and students are actively participating in various technology and innovation events such as RoboCon, winter or summer information technology (IT) camps, the Internet Robotics Inter-School competitions (IRIS), etc. For example, the numbers of participating schools and students in the IRIS 2007 reached 180 and 1500, respectively. The active participation in technology events demonstrated strong interests of local schools and students in design and innovation. The works created/innovated by the students in those activities are with high quality, showing the ability of students' to blend their creativity with practicability. This proves that Hong Kong students have unlimited potential in innovation, design and technology which is to be uncovered whenever there is appropriate opportunity.
- **Resources dedicated to Design and Technology education are limited:** Although technology education, as one of the 9 Key Learning Areas (KLAs), is welcome by local students, readily-available resources for technology education are seriously in lack. It is evidenced by their low level of availability of teaching resources compared to other subject areas. Most of those available resources are limited to fundamental knowledge with focus on IT education, Home Economics and Commerce. Although the students are active in various technology competitions, there is no sufficient facility supporting their activities. There is even no education package that teaches the students underlying principles and trains their skills in using fundamental knowledge in system design and helps them develop the sense of creation.
- **Internet provides effective solutions to the resources shortage problem:** Internet can be accessed anytime from anywhere, and hence it can provide an effective and cheapest solution to the recourses shortage problem. Schools can share Internet

resources. Many Internet resources, like IT campus, Small campus, have been developed used in Hong Kong for education in subjects like Chinese, English, Mathematics, and IT for years. Internet education has been proven effective for students to enhance their understanding of the subject knowledge through self-learning and self-exploration. Existing Internet education resources are focused on helping students review concepts and principles by providing selective questions for them to choose. While selective questions do enhance students' understanding on subject knowledge, the students cannot gain training in innovation and design, which are core elements in technology education. There is no Internet resource dedicated to Design and Innovation education, so it is highly demanded to develop an Internet platform by which students can explore design and technology on-line and develop their skills and sense of creation through project-based self-learning.

- **Project-based learning is a widely-adopted strategy in technology education:** Project-based learning aims to motivate students to learn by interacting with each other in small groups, while teachers are no longer the one who 'teach' but to 'facilitate' the learning process. In project-based learning, students are expected to set their own learning targets, design learning tasks, practise self-regulated learning and perform self-assessment, which fit well into the goals as stated by the Curriculum Development documents of EDB. Therefore, developing proposed Internet resources will enable not only schools to develop their projects but also students to explore project-based learning on-line by themselves.
- **Design from components is the most suitable for primary and secondary students to explore:** Lego company has been successful in marketing their assemble toys that enable children build toys from "bricks". It is widely recognized that Lego toys help children develop their sense in design and creation. Lego recently developed a software package called "LEGO digital designer" which helps children build their own toys from the "bricks" provided. However, LEGO digital designer does not incorporate electronic components such as sensors, actuators, IC components, programming, which are essential in technology education. Moreover, it does not support 3-D simulations and accept 2-D drawings as initial designs, while the system we intend to develop will be able to solve those issues.
- **Robot is one of the most attractive platforms for design projects:** It has been proven worldwide that robotics education is one of the most effective approaches to arouse the interests of young generation to innovation and technology. Robotics is an interdisciplinary subject and a robot represents highly intelligent integration of state-of-the-art technologies in information engineering, computer engineering, design, mechanical engineering, electronics, and automation engineering. Therefore, using robots as the examples in project-based learning can cover most of the aspects in Design and Technology subject. Moreover, using robots in Design and Technology education can certainly attract more students and generate direct and effective results.

Therefore, to promote Design and Technology education in Hong Kong, it is highly desirable to develop an Internet platform that enables students to carry out design projects using a library of components including mechanical bricks, sensors, actuators, electronic components, micro-processors, etc. with supporting 3-D interactive design interface and simulation tools.

(b) Readiness of the applicant organization for undertaking the project

i. MAE is a leading academic institution in research and education of robotics and design

- The Department of Mechanical and Automation Engineering (MAE) of CUHK plays a leading role, locally and internationally, in research and education of latest technologies in robotics, design, control and computer engineering. The Department has been very successful in technology transfer and research grant application. It has also been very active in organizing international conferences in the robotics and design related technological areas and bringing those events to Hong Kong and China. Faculty members have excelled in publication of high quality research journals.

- In additional to its well established research excellence and international connection, MAE has also devoted strong efforts in educating the next generation of Hong Kong. Through organising different talks, seminars, exhibitions and competitions in collaboration with secondary schools and other education organizations, MAE has been experienced and successful in recruiting potential students for advance technology and engineering education as well as bringing junior students to explore the beauty and wonder of the ever-changing world of technology. Specifically, MAE developed a fully-featured robotics curriculum with support software and hardware development kits under the sponsorship of the QEF and implemented the curriculum in 24 secondary schools as a subject course. MAE also developed the software and hardware platform for the Internet-based robotics competition and has been successfully organizing the IRIS competitions since 2005. To coordinate technology education in secondary schools in Hong Kong, the Faculty of Engineering set up the Centre of Robotics and Technology Education. The Centre has been actively organizing various technology education activities. (See Appendix I)

ii. Experienced professionals as collaborators of the project

- HKTEA is a group of professional teachers devoted to promote technology education in local secondary schools. They have been active in connecting schools with local and international activities and providing supports to talks, conference, workshops, seminars, exhibitions and competitions organised by many professional bodies for the enhancement of students' technological literacy. Activities they co-organised in 2005 include the IRIS Competitions in 2005-2008, Robotics and Automation Technology Seminar, Hong Kong Student Science Project Competition and Chiang Chen MEMM Technology Workshop. They also collaborate with HKEdCity to maintain the webpage of 'Design and Technology Teaching Forum', delivering updated news about latest activities and teaching resources in relation to Design and Technology education.

iii. Strong support from secondary schools

- This project has received strong support from local secondary schools. Seventeen secondary schools have undertaken to send their teachers of relevant subjects to attend various activities organized by this project, such as training workshops and sharing sessions, as well as to implement the on-line design curriculum at their schools. The seventeen supporting schools are as follows (Please refer to the acceptance letters in Appendix III)

- CCC Tam Lee Lai Fun Memorial Secondary School (中華基督教會譚李麗芬紀念中學)

- Chang Pui Chung Memorial School (張沛松紀念中學)
- Cheung Chuk Shan College (張祝珊英文中學)
- Clementi Secondary School (金文泰中學)
- Ho Yu College and Primary School (Sponsored by Sik Sik Yuen) (嗇色園主辦可譽中學暨可譽小學)
- Kwok Tak Seng Catholic Secondary School (天主教郭得勝中學)
- MKMCF Ma Chan Duen Hey Memorial College (馬錦明慈善基金馬陳端喜紀念中學)
- Po Leung Kuk Tang Yuk Tien College (保良局董玉娣中學)
- Shau Kei Wan East Government Secondary School (筲箕灣東官立中學)
- SPHRC Kung Yik She Secondary School (十八鄉鄉事委員會公益社中學)
- STFA Seaward Woo College (順德聯誼總會胡兆熾中學)
- T.W.G.Hs. Chang Ming Thien College (東華三院張明添中學)
- T.W.G.Hs. Kap Yan Directors' College (東華三院甲寅年總理中學)
- T.W.G.Hs. Yow Kam Yuen College (東華三院邱金元中學)
- Tang Shiu Kin Victoria Government Secondary School (鄧肇堅維多利亞官立中學)
- Wa Ying College (華英中學)
- Ylpmsaa Tang Siu Tong Secondary School (元朗公立中學校友會鄧兆棠中學)

(c) Applicant organization's other favourable factors / facilities for implementing the project e.g. experience in implementing projects or activities of a similar nature

The research team consists of education experts from both university and secondary schools. They all have extensive experiences in technology education and research in robotics and information technology. The team members have completed many projects funded by the Hong Kong Research Grants Councils (RGC), the Innovation and Technology Fund (ITF) as well as the Quality Education Fund (QEF). The team also includes experienced practitioners in education of local secondary schools.

- The Principal Investigator, Professor Yun-hui Liu, has been the Principal Investigator of more than 20 projects supported by the Hong Kong RGC, the National Science Foundation of China and industry. His work has been most about automation and robotics. He has produced over 100 publications. He was an Associate Editor of IEEE Transactions on Robotics and Automation. He has carried out many original works in robot control, remote sensing and control via the Internet and wireless communication networks, sensor fusion. He and his collaborators built the first Internet system connecting robots in USA, Japan, China and Hong Kong. He and his team developed the platform for the Internet Robotics Inter-School competition (IRIS) and have been organizing the first IRIS competitions since 2005. He is the PI of the project "Innovative technology education using Internet based robotics competitions" sponsored by QEF. In this project, he developed a fully-featured robotics curriculum and implemented it in 24 local secondary schools.

- The Co-investigator, Professor Yeung Yam, is an expert in fuzzy logic, intelligent control, dynamics modelling and system identification. He has a wide range of experience in engineering, research and teaching. He has previously worked on satellite dynamics and control at the Jet Propulsion Laboratory in U.S.A. Since joining the Chinese University of Hong Kong, he has been the Principal and Co-Principal Investigator of numerous RGC and ITF grants. He serves in the Editoral Advisory Board of the *Journal of Intelligent & Fuzzy Systems* and has published over 100 technical papers in various areas of his fields. His knowledge in fuzzy logic will contribute to controlling the soccer robots via a more rule-based design, while his expertise on the autonomous formation and reconfiguration of robot units will add to the element of overall "teamwork" in the game plan. He will help to develop the teaching material for robot control strategies.
- The Co-investigator, Professor Kam-Fai Wong, is an expert in information systems and Internet technologies. His research interest focuses on Chinese computing and parallel database and information retrieval. He has published over 130 technical papers in these areas in various international journals and conferences and books. He is a member of the ACM, CLCS, IEEE-CS AND IEE (UK). He is the founding Editor-In-Chief of ACM Transactions on Asian Language Processing (TALIP), co-Editor-in-Chief of International Journal on Computer Processing of Oriental Languages and a member of the editorial boards of the Journal on Distributed and Parallel Databases and International Journal on Computational Linguistics and Chinese Language Processing. He is the PI of the project: "School eNewsletter" funded by the Quality Education Fund (QEF) (HK$2.6M *Project Ref. No.: 2003/0562)* .
- The Co-investigator, Mr. Antony Wai-Yip Leung, is the Chairman of Hong Kong Technology Education Association (HKTEA) and an experienced teacher in a secondary school. He has been actively engaging in technology education for secondary students for a long time. He organized various robotics competitions for secondary students, and played one of the major roles in the first IRIS competition in July, 2005.Mr. Leung has been the PI and Co-I of several projects funded by the QEF, which include "Joint school robotic olympaid 2002", "Ocean exploration programme", and "School-based curriculum development of the subject "Design and Technology"". His experience will help the research team to correctly address the needs of the secondary students. His role will be to coordinate our curriculum development and implementation at the supporting schools.

12. Project Description

(a) goals and objectives

The goal of this project is to promote Design and Technology education and to develop students' life-long self-learning capability and their sense of creation through learning the on-line design curriculum, exploring the on-line design tools, and participating in the on-line design projects and competitions. By virtue of the on-line resources to be developed, students can actively engage in self-learning and project-based learning, and gain knowledge and experiences in mechanical design, system design, robot design, computer programming, Internet technology, etc. Specifically, we aim to achieve the following objectives:

- To motivate senior primary students and secondary students to learn independently advanced technologies using on-line design education resources.

- To develop students' learning capability and sense of creativity by stimulating their initiatives to learn and providing on-line problem-based learning environment and materials to design and innovation.
- To promote technology education in Hong Kong by appraising students' innovation and efforts demonstrated in design competitions.

By taking the proposed training, the students are expected to develop:

- their basic knowledge in design, robotics, mechanical engineering, computer engineering, and Internet technology in the on-line project-based learning environment.
- their capability of applying their knowledge in design, robotics and programming to specific design tasks by utilizing the on-line design tools.
- the nine generic skills, as stipulated in EDB's document, through students' active participation in the on-line learning process and in the competitions.
- their understanding of impacts of technology to the local and global societies.

(b) Targets and expected number of beneficiaries

Since the Internet education resources to be developed are accessible from anywhere, all students in Hong Kong can benefit from the outputs of this project. The users can be divided into two groups: (a) users of the on-line education curriculum in school education and (b) users of the on-line resources for self-learning and exploring design projects and competitions. Following are the estimated numbers of beneficiaries when the project is completed:

- Students using the resources for their subject learning:
  17 supporting schools x (2 teachers + 230 S.2 students) = 3,944
- Students and general public using the resources for other purposes:
  Self-learning: 50 people /day * 365 days = 18,250
  Design competition: 3000 per year.

We believe the number of the users will increase dramatically in a few years after completion of the project.

(c) extent of teachers and principals' involvement in the project

i. Involvement of teachers

- Take part in the design of the on-line design and innovation curriculum and the development of the supporting software packages by contributing their expertises and experiences in technology education in schools;
- Develop and implement their school-based curriculum for design and technology using the Internet education resources;
- Learn to monitor students' progress and assess their achievements in a school-based context;
- Equip themselves with professional and updated knowledge in technology, realizing continuous professional development by participating in the training workshops, seminars and other activities in this project.

ii. Involvement of principals

- Play a leading role in overseeing the development and implementation of the

school-based curriculum for design and technology education;

- Monitor the progress of the project to ensure it follows the specific needs of their schools.
- Facilitate inter-school collaboration.

(d) implementation plan with time-line

i. Major tasks

The proposed project consists of four major tasks: (1) development of the Internet education resources for design and innovation, (2) implementation of the design curriculum in schools, and (3) organization of design and innovation competitions using the on-line design tools.

(1) Development of the Internet Education Resources

Our aim is to develop the Internet resources for design and innovation education with supported 3-D design and simulation tools to facilitate local secondary students to learn fundamentals of design and innovation and to develop their skills in design and creation through on-line design projects. The core part is the design and development of a fully-featured curriculum both for self-learning and class-teaching of design and innovation. The curriculum will be carefully designed so as to fit the objectives of technology education set by EDB and to be integrated with existing Design and Technology courses offered in secondary schools. The unique features of this curriculum include that the students will use the on-line resources to learn the theories and to carry out design projects via the Internet. It is expected that the curriculum will take 2 months if taught in class. The curriculum will consist of five modules highlighted as follows:

- Module 1 – Introduction to Design: This module will give the students a brief introduction to design and innovation including the problem definition, historical perspectives, etc.
- Module 2 – Design Process: The module will teach students the major steps for carrying out design in a design cycle.
- Module 3 – Design Analysis and Evaluation: The module will introduce the criteria for evaluating design works and the methods for carrying out design analysis and evaluation.
- Module 4 – Design Tools: This module will teach students how to use the on-line interactive design and simulation tools to conduct design.
- Module 5 – Design Projects: This module will teach students how to develop their design skills and creativity through on-line design projects.

One of the major tasks in this project is to develop the on-line design and simulation tools. As mentioned before, we will specifically use projects of designing robots from components/parts to train students' skills and creativity in innovation and design. To facilitate students' learning, the on-line design and simulations resources will have the following unique features:

- Design from components: There is a library which stores a large number of components including mechanical "bricks", sensors, actuators, micro processors, electronic components, etc, which can be purchased from industry. The students will design their products using the components provided. The component library can be customized as personalized one based on interests of individual students. Students can also add components to their personalized library by themselves.
- 3-D interactive design: Unlike 2-D approaches adopted by design engineers, students will design their products in 3-D directly using the powerful graphics engine provided by the

software. With 3-D design, the students can really build their product from components like what children build their LEGO toys from "bricks".

- Initial design input from 2-D drawings: The software will allow students to input their 2-D drawings as initial designs by incorporating image processing and recognition technology with the system. The on-line system can recognize 2-D drawings of students and automatically map them to 3-D products or robots that can be built from the components library. Then, the students can use the interactive design tool to modify their designs. This function can significantly shorten the design process and is particularly useful for junior students.
- Components search function: Optimization and search technique will be developed so that the students can search components by inputting abstract meanings such as "small legs", "fat body", "small head", etc. Furthermore, with this function, during a design process a list of candidate components will be also generated from the huge database so as to reduce the designer's workload and speed up the process.
- 3-D simulation: The 3-D simulation tool enables the students to view the 3-D motion of their products after they complete the design.
- Prototyping and production: Once the students are satisfied with their design, they can request the collaborating manufacturers to prototype or fabricate the product with fee.
- Design sharing and competition: The on-line software platform will also allow the students to share their design with their peers and participate in the on-line design competitions.

Appendix 1 shows the schematic diagram of the on-line design and simulation software to be developed. We will develop models of the components, the database, the interactive design interface, the 2-D drawing processing and recognition algorithm, the component search method, and the 3-D graphic simulation software.

(2) Implementation of the Design Course

The design curriculum can be used for on-line self-learning as well as in-class teaching as a part of a technology subject. To promote this curriculum among secondary schools, we will collaborate with the supporting schools to implement it as a subject course.

To facilitate the implementation, we will organize training workshops for teachers at secondary schools to utilise the on-line design and simulation tools. The workshops will also serve the purpose of providing an opportunity for teachers from different schools to exchange their ideas and experiences in designing and implementing the curriculum. Through the workshops, we can also collect views of the teachers.

The training workshops for the teachers at the supporing schools will start from late September in 2009. There will be 4-6 3-hour workshops. The 3-hour workshop is broken down into 3 parts, while the 1st part will be teaching teachers to learn the on-line design and simulation tools; the 2nd part will be sharing of user comments; and the 3rd part will be for the teachers to further discuss detailed specifications of the curriculum. Trainers of these workshops will be from MAE and HKTEA.

After the training workshops, teachers will implement the design curriculum in their technology education class. Teachers are expected to assist students in acquiring the subject knowledge (i.e. design, robotics, mechanical engineering, computer programming) by creating a suitable learning environment to leave huge space for students to explore and discover their talents in technology and creativity, at the same time to demonstrate generic skills, specifically the problem-solving

skills, communication skills and self-management skills. Teachers are also expected to actively share their experiences in implementing the proposed design and innovation curriculum with teachers from different schools.

(3) Internet-based Design Competitions

As an essential part of this project, we will organize an on-line design competition once a year so that the students can demonstrate their learning results in the design curriculum. The competition will motivate students to spend more time and efforts on learning technology and designing and building their products using the on-line resources. As a result, the students would be able to gain solider knowledge in mechanical design, electronics, information technology and robotics.

We will choose robots as examples of the design projects because robotics is an interdisciplinary subject integrating mechanical engineering, electronics, control engineering, and computer engineering and most concepts in design and technology can be covered.

The competition will be integrated with the existing Internet Robotics Inter-School competition (IRIS) organized by CUHK and HKTEA. In the competition, students will use the on-line design and simulation tools to design their robots and submit them on-line for competition. The initial evaluation will be conducted based on the on-line design works. The finalists selected from the initial evaluation will be asked to build their products using the components. Then, the students will compete in the final games by demonstrating performance of their design works.

By organizing and participating in the competitions, the students will able to evaluate their own design works, and to learn generic skills in event organization, team work, etc.

The competitions are scheduled to be held as one of the key components in IRIS 2009 and IRIS 2010. In IRIS 2009, which is expected to be held in July, 2009, as only the skeleton of the curriculum is ready, we will only invite a number of co-organizing schools to join as the pioneers. In IRIS 2010, the curriculum will be ready and we will invite all co-organizing schools to join. The competition will be the milestone of the curriculum development. On the other hand, we will try to invite students from China and overseas to join the competition to provide an opportunity for students to exhibit their creation work.

ii. Implementation plan

We propose to develop and implement this project in the following four stages:

- STAGE 1 (04/2009-09/2009): Design the Internet design platform and the design curriculum. The details of the work are as follows:
  - Collect views from teachers and principals on design and development of the design curriculum.
  - Design the Internet education platform for design and innovation.
  - Develop models of components and the component library
  - Develop the 3-D graphic interface
  - Collect the baseline data for later evaluation.
  - Generate the first progress report.

- STAGE 2 (10/2009-03/2010): Develop the design-from-components software and curriculum modules. The work is detailed as follows:
  - Develop the software for design from the component library
  - Develop the component search software

- Develop the on-line design curriculum materials.
- Design the 3-D simulation tools
- Complete the second progress report.

- STAGE 3 (04/2010-09/2010): Develop the design simulation tools and organize training workshops. The work is detailed as follows:
  - Complete the development of the Internet design simulation tools;
  - Develop the 2-D drawing processing and recognition tool;
  - Train the teachers at the supporting schools for implementing the design curriculum.
  - Organize road shows, exhibitions and information seminars at different occasions to promote the developed curriculum to all secondary schools in Hong Kong.
  - Tune the curriculum based on feedbacks from the students, teachers, principals and parents.
  - Organize the on-line design competition as one of the events of the Internet Robotics Inter-School competitions (IRIS).
  - Generate the third progress report.

- STAGE 4 (10/2010-03/2011): Implementation of the curriculum, organization of the design competition, and evaluation of effectiveness of this project in technology education
  - Implement the design curriculum at the supporting schools
  - Collect the performance indicators stated in the evaluation scheme.
  - Assess the effectiveness of this project in technology education and its social impact.
  - Improve the curriculum and the on-line design and simulation tools based on the evaluation results.
  - Generate the final project report.

iii. Collaborations among the parties involved

- CUHK is responsible for developing the design curriculum and the on-line design and simulation tools. The HKTEA and the supporting schools will provide advices in design of the curriculum and the on-line resources.
- The supporting schools will send teachers to attend the training workshops, implement the proposed design curriculum at class-teaching of their secondary students with support from CUHK and HKTEA, and to organize the students to participate in the on-line design competition. .
- CUHK, HKTEA and the supporting schools will also collaborate in assessment of the effectiveness of the project in design and technology education of secondary students and revision of the curriculum. They will work hand-in-hand for providing better technology education for Hong Kong students.

(e) expected deliverables and outcomes

i. Expected deliverables:

1) An Internet design education platform for students to learn fundamentals of innovative design and to develop their skills and creativity in design projects using on-line 3-D interactive design and simulation tools.
2) A fully-featured design curriculum with support on-line resources for self-learning or in-class teaching of secondary students.
3) Organizing of an Internet design competition, which can serve as a platform where students' can show off their learning achievements and interact with opponents from outside Hong Kong. The competition can also serve as one of the assessment points where teachers can observe how students demonstrate their subject knowledge and generic skills through their participation.
4) Three interim reports and one final report documenting the progress of the project, the effectiveness of the design curriculum in technology education, impact and evaluation of the project.
5) A number of information seminars, workshops and sharing sessions for teachers to refresh their knowledge in design and technology and to exchange their opinions on the development of curriculum and experiences during implementation of the project.

ii. Expected outcomes:

For students:

- Learn effectively and fuse subject knowledge in design, mechanics, computer and Internet through the active participation in this project.
- Obtain experiences in performing design projects using the on-line resources.
- Discover their potential in design and technology which encourages them to take initiatives to participate in various learning activities in areas related to the subject area.
- Gain satisfaction by going through the challenges during idea formulation, configuration, fine-tuning and troubleshooting stages leading to final completion of their own products
- Understand impacts of design and technology in relation to local and international context.
- Master generic skills and develop a holistic world view which can be transferred to other in-school and real life situations.

For teachers:

- Update their subject knowledge by attending the training workshops.
- Acquire skills to use the on-line design and simulation tools to inspire students' talents in design and technology.
- Acquire experience in facilitating a collaborative learning project, which involves motivating students to actively take part in group discussions, self-learning and generic skills development, and creating a suitable learning environment for students to put collaborative learning into practice.

For principals:

- Acquire experience in developing school-based curriculum.
- Acquire experience in managing joint-organization activity for school and curriculum

development

iii. Commercialisation potential of deliverables/outcomes

- The on-line design and simulation tools can certainly be put into the market for interested parties to commercialize.
- The training workshops could be further modified and developed into an option for professional training for teachers and other interested parties.
- The on-line design curriculum can be offered as an extra-curricular course for students interested in technology to learn after schools.
- Exceptionally high quality products by students, with support from investors and professionals in the field, could be further developed to serve different purpose which may have commercial value.

(f) Budget with detailed breakdown (please refer to Appendix II for justifications)

(a) Staff Cost		
(i) Project Coordinator * 1 Monthly salary: $16,500 * 1.05 * 24 months	$	415,800
(ii) Senior Research Assistant * 1 Monthly salary: $18,600 * 1.05 * 18 months	$	351,540
(iii) Research assistant * 1 Monthly salary: $15,800* 1.05 * 12 months	$	199,080
(iv) Research assistant * 1 Monthly salary: $13,000 * 1.05 * 18 months	$	245,700
Subtotal	$	1,212,120
(b) Equipment		
(i) Internet server	$	100,000
(ii) Software development tool	$	40,000
(iii) 2D input devices for students	$	100,000
(iv) Computer for competitions & staff	$	78,000
Subtotal	$	318,000
(c) General Expenses		
(i) Publicity cost		20,000
(ii) Training materials (for teachers' workshops)		15,000
(iii) Publication of curriculum materials		15,000
(iv) Organization of the competition:		25,000
(v) Other expenses (including cost for external auditor)		25,000
Subtotal	$	100,000

(d) Contingency		
Insurance, system failure etc.	$	12,540
Subtotal	$	12,540
(e) University Overhead		
6% of the total expense	$	114,140
Subtotal	$	114,140
TOTAL SOUGHT	$	1,756,800

13. Project Impact

(a) evaluation parameters and method

- A committee, which consists of school principals (or their representatives) and education professionals, will be set up to assess the effectiveness of the proposed project in technology education. The committee will meet regularly to advise the development and monitor the progress throughout the project period. At the end of each project stage, an evaluation report will be produced.
- In addition to the evaluation committee, we hold regularly meetings with principals, teachers and students, and collect opinions from parents by questionnaires.
- Proposed performance indicators, as derived from the goals and objectives of the project, include
  - generic skills development of the students;
  - value and attitude change of the students;
  - subject knowledge enhancement of the students, with comparison with previous students who did not participate in the activities in the project;
  - degree of students' and teachers' active involvement;
  - social impact of the project; and
  - number of students using the Internet resource and participating in the competitions.

(b) How the project would benefit the education sector as a whole

- The Internet education resources can be widely adopted by secondary schools in Hong Kong for technology and innovation education as a teaching resource for students and teachers. It also provides a starting point with necessary materials for teachers and students to further explore the possibilities to modify the curriculum in order to fit into their unique objectives and needs.
- Teachers and principals of secondary schools will have valuable opportunity to

actively engage in curriculum development, facilitation of collaborative learning and inter- and intra-school collaborations so as to realise professional development.

- Future students can be benefited by the impacts brought about by implementation of this project as their potentials in design and technology will receive much more encouragement and appreciation from teachers and parents due to the positive change of general attitude towards technology education.

(c) sustainability of the outcomes of the project

The outcomes of this projects can be used for a long term because

- It is anticipated that the design and innovation curriculum will be fully integrated into the technology course and become one of the most important elements in technology education after the completion of this project. Therefore, the course can be offered for a long term as soon as the supporting Internet resources are available.
- The maintenance cost of the Internet resources for design and innovation education is relatively low after the completion of this project, we can use the University internal resources to cover the expenses. Furthermore, membership and advertisement fees can be additional means to generate income to sustain the long-term development.
- The Internet design competition will be integrated into the IRIS, which has been continuously sponsored by the Shum Hing Education and Charity Fund.

(d) dissemination / publicity methods

The Centre of Robotics and Technology Education of CUHK will play the major role in disseminating and publicizing the outputs of this project. Following is the detailed plan for publicity:

- To promote the Internet resources for design and innovation education to secondary students, we will organize an Internet design competition every year. The competition will be integrated to the Internet Robotics Inter-School competition (IRIS). The Centre has been successfully organizing the IRIS since 2005 and IRIS is becoming one of the most important technology events in Hong Kong (Please see the attachment). We will closely collaborate with secondary schools and HKTEA in organizing the events.
- We have invited 17 secondary schools to participate in this project (please see the list of the secondary schools in Section 11(b)(iii). The schools will implement the proposed design curriculum in their subject courses and organize their students to participate in the competitions. More schools will be invited in 2010. It is expected that more schools will join this project.
- We will also organize workshops or information seminars to students and general public to promote the Internet design tools. In promoting this project, we will closely collaborate with local education bodies or mass media such as HKEdCity, local newspapers, RTHK, etc. as well as local industry.

APPENDIX

Appendix I

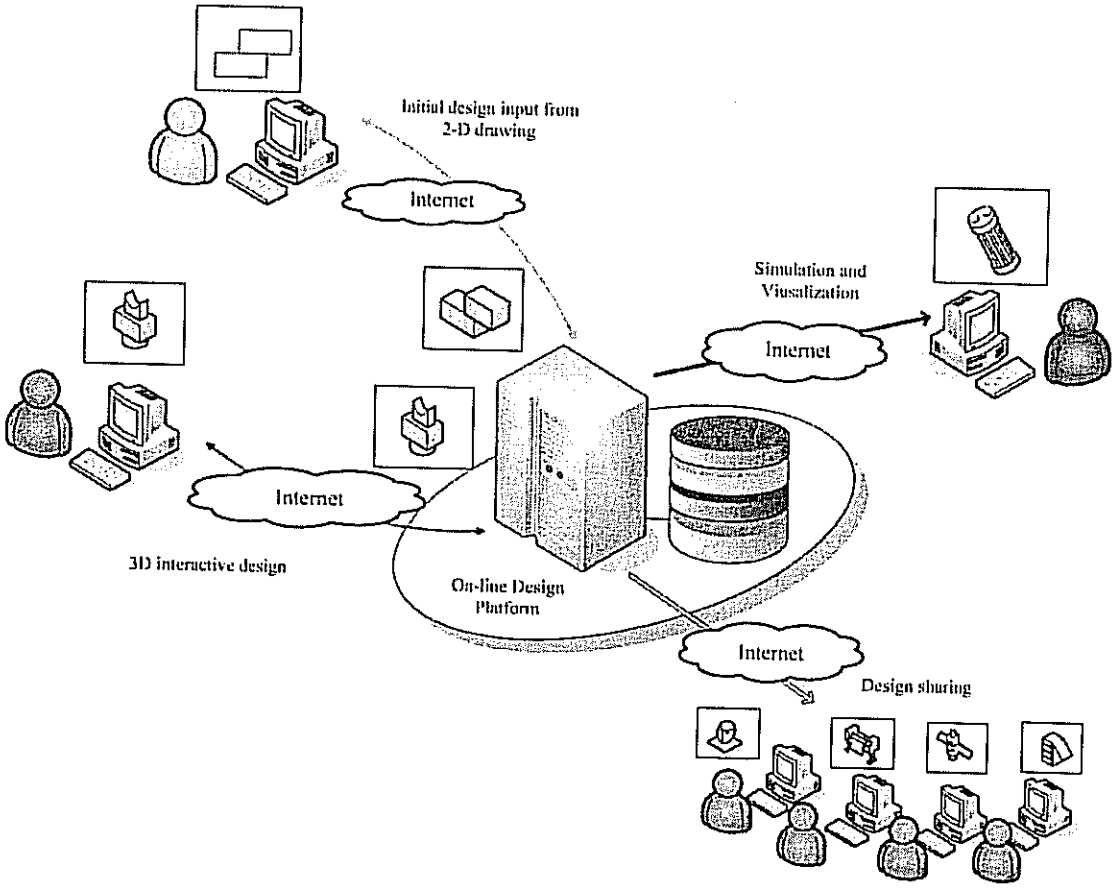

Fig. 1 The diagram of the Internet design and simulation tool

Appendix I

Innovation and Technolog Education Activities Organized by CUHK

A. Internet Robotics Inter-School compeitions (IRIS)

The Faculty of Engineering has been organizing the Internet Robotics Inter-school competitions (IRIS) since 2005. The IRIS competitions consist of three-levels games, namely IRIS-1, IRIS-2 and Outlook design competition. In the IRIS-1 games, the students use the standard robots prepared by the organization committee to tele-control robots in soccer games. In the IRIS-2 games, the students must design and build their own robots and develop relevant programs so that they can better demonstrate the creativity and learn more about robotics, Internet technology and computing programming through the hands-on work. In the Outlook Design competition, the students need to design outlooks for their IRIS-2 robots under a given theme.

The 1st Internet-based Robotics Inter-School (IRIS) competition was held in 2005 with participation of 60 teams from 20 schools. Over 300 teams and 1500 students from about 150 schools took part in the IRIS 2007. This year the IRIS competition has been extended to major cities such as Beijing, Shanghai, Shenzhen and Guangzhou. The competitions were widely reported by RTHK, TVB, Phoenix TV, web-TV, local newspapers, and web news. Fig. 2 shows the snapshots of IRIS 2007. Fig. 3 presents some of the robots developed by the local secondary students for the IRIS-2 games. The robots demonstrate the creativity of the students and their ability in innovative robot design, computer programming, and use of information technology.

B. Development and Implementation of Robotics Curreiculum for Secondary Students

Under the sponsorship of the previous QEF project "Innovative technology education using Internet-based robotics competition", we developed a fully-feature robotics curriculum for secondary schools. The curriculum consists of two-levels courses designed for students at different levels. The basic level course is for F. 3 students, focusing on the fundamentals of robotics, while the advance level course is for F. 4 students with emphasis on robot design and programming. The robotics curriculum has been implemented since spring 2007. In 2008, 22 econdary schools are teaching this course as a part of their Design and Technology subject. Fig. 4 shows the robotics DIY kit for the basic modules and the textbooks. The students participating in this course are shown in Fig. 5 The curriculum has received good response from local secondary schools and students.

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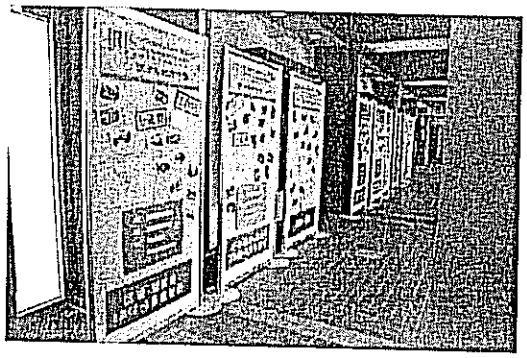
C. China International Scientific Life Exhbition

We have been invited to join the China International Scientific Life Exhbitiion (第二屆中國(深圳)國際科學生活博覽會) from April 5 to 8, 2008 in Shenzhen, China. We have corrdinated a team of 100 teachers and students from 9 secondary schools. More than 150 pieces of CRATE's works and outstanding students' works were exhibited. We also joined the "Hong Kong – Shenzhen IRIS Competition". Fig 6-8 show the newpaper reports and snapshots of the events.



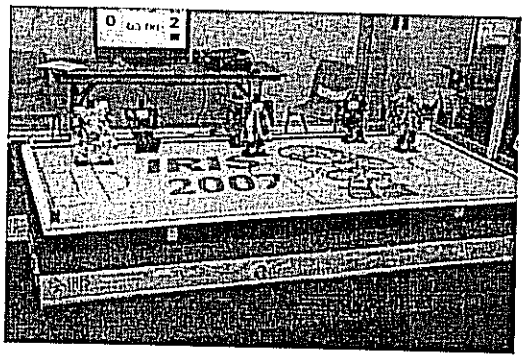


Fig. 2 Snapshots of the IRIS competitions in May, 2007.

Appendix I

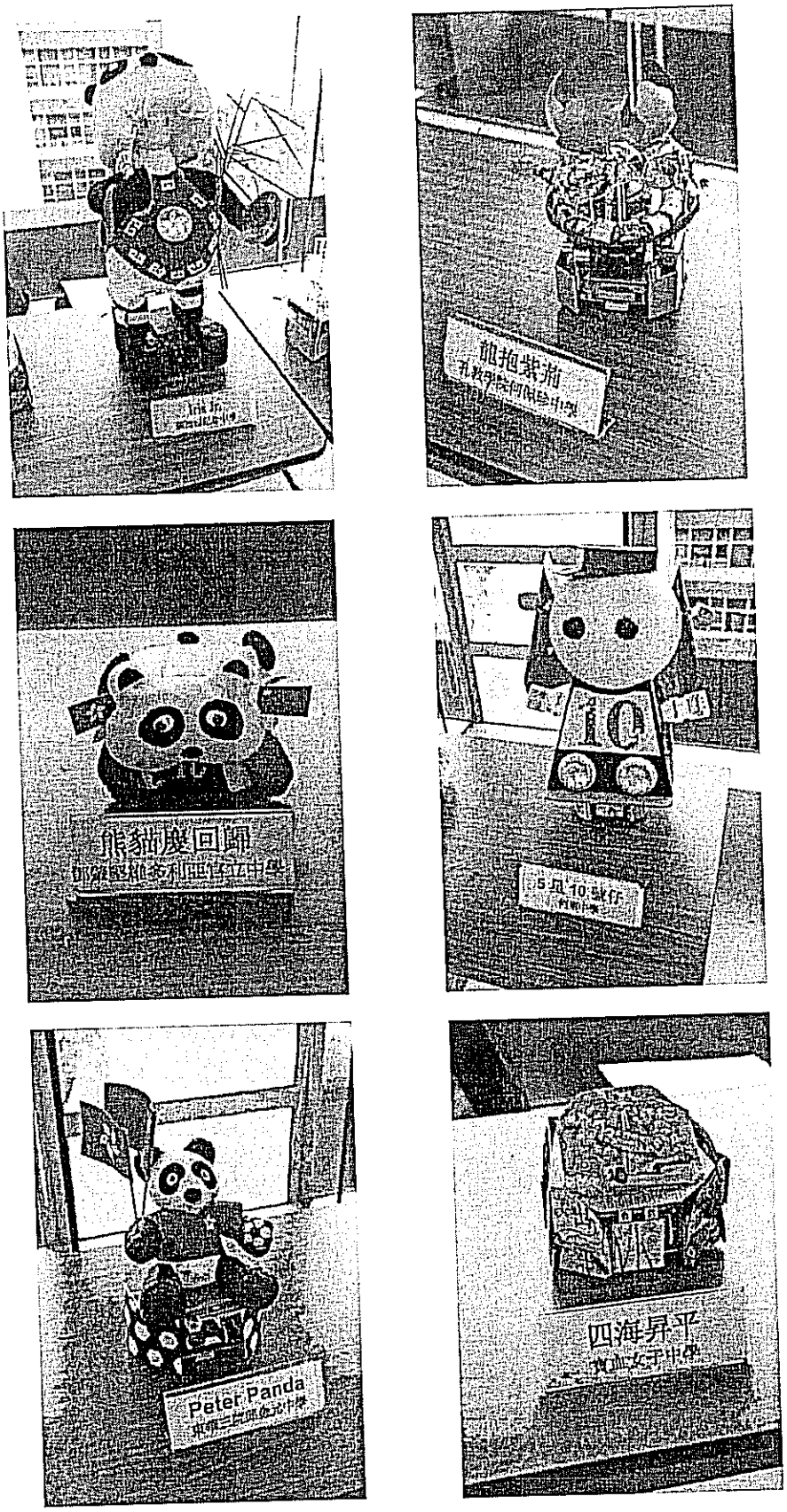


Fig. 3 The robots designed and built by the students.

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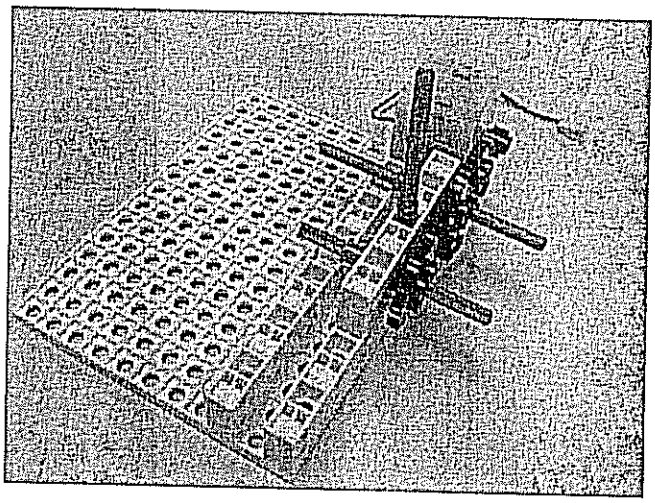

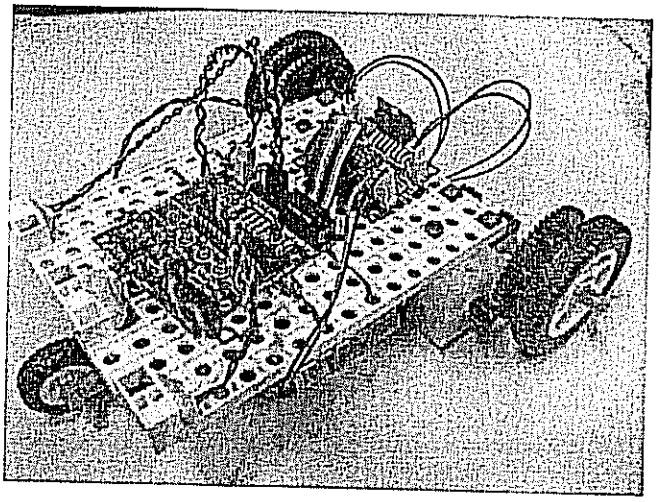

Fig. 4 The robotic curriculum materials.

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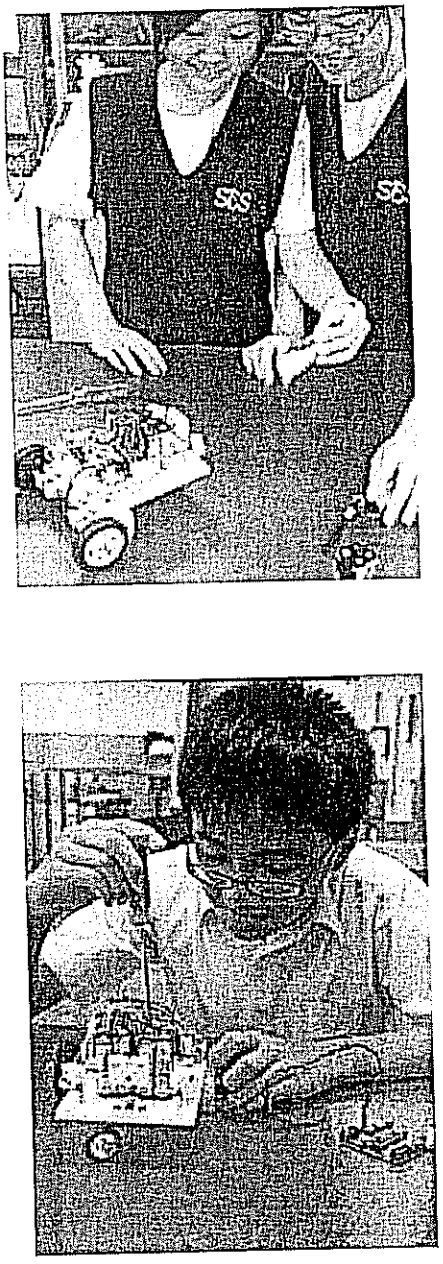

Fig. 5 Students taking robotics lesson.

Appendix I

深港青少年互联网机器人足球赛开锣

孩子们场外动手 机器人场内动脚

【本报讯】【记者 陈颖】昨日天气晴好暖意融融，首日开展的科博会更是热闹无比。在科博会设置的青少年科普版块中，首次围绕深港两地青少年展开的"长城杯·深港青少年互联网机器人足球友谊赛"一开始就抓住青少年与家长们关注与参与的目光，比赛在里三层外三层"包围"中紧张进行。

上午9时30分，准备就位后，由香港和深圳组成的足球赛手开始了各自的对决，足球比赛正式开始。记者在现场看到，此番足球比赛与众不同：首先，双方只有一位青少年作为队员代表，这位队员要通过网络技术来操作各自的三位"机器人"球员进行对决。其次，大家看到的机器人比赛是在一个乒乓球桌大小的场地上比试，而操纵者则是在一旁的电脑场景中模拟对决。

虽然这些"机器人"球员长得四四方方，看上去十分笨拙，但随着双方操作员的指尖在电脑键盘上灵活游走，得到指令的"机器人"队员在场上左冲右突，带球、补位、铲断、射门、扑球……各种进攻防守动作有板有眼，及时到位，显得非常敏捷灵活。随着比赛时间的不断推进，场上不断出现险情，双方攻守局面几度改变，对决越来越激烈，气氛越来越紧张。在僵持了一段时间之后，其中一方终于抓住对方长驱进攻后补位不及的空当，机智地打起了防守反击，迅速带球突破，施以了一脚劲射。对方"守门员"扑救不及，足球应声入网！一场10分钟的激战，最终在胜利方的欢呼声中以1:0结束了。

据了解，"长城电脑杯·深港青少年互联网机器人足球友谊赛及作品展示"活动是青少年科普活动版块的重头戏，是由深圳市科学技术协会主办，长城计算机公司赞助，由深圳市青少年科技教育协会、深圳市青少年活动中心、香港中文大学等单位共同承办的。该活动突出两大亮点：一是机器人引领科技新潮流；二是深港合作开创科技发展新局面。

而此次机器人友谊赛共有36支深港机器人队伍参加，其中深圳24支队，香港12支队，均是在深港两地分区选拔赛中胜出的优秀队伍。香港参赛学生约100人，深圳参赛学生约300人。比赛为期一天，现场采用淘汰对抗赛方式，最终决出深港友谊赛冠、亚军。赛果将在今天下午公布。

对于以深港两地青少年开展的机器人活动展，香港中文大学的刘云辉博士表示，这是近年来深圳和香港开展青少年科技创新交流活动的一次集中展示，机器人引领了科技新潮流，深港合作也将开创科技发展的新局面。"借机器人友谊赛为平台，能够促进深港两地科技繁荣发展，并通过加强两地交流来增进深港青少年友谊，加快深港融合基础进程！"

Fig. 6 Reports and snapshots on Shenshen Exhibition (1)

Appendix I

Fig. 7 Reports and snapshots on Shenshen Exhibition (2)

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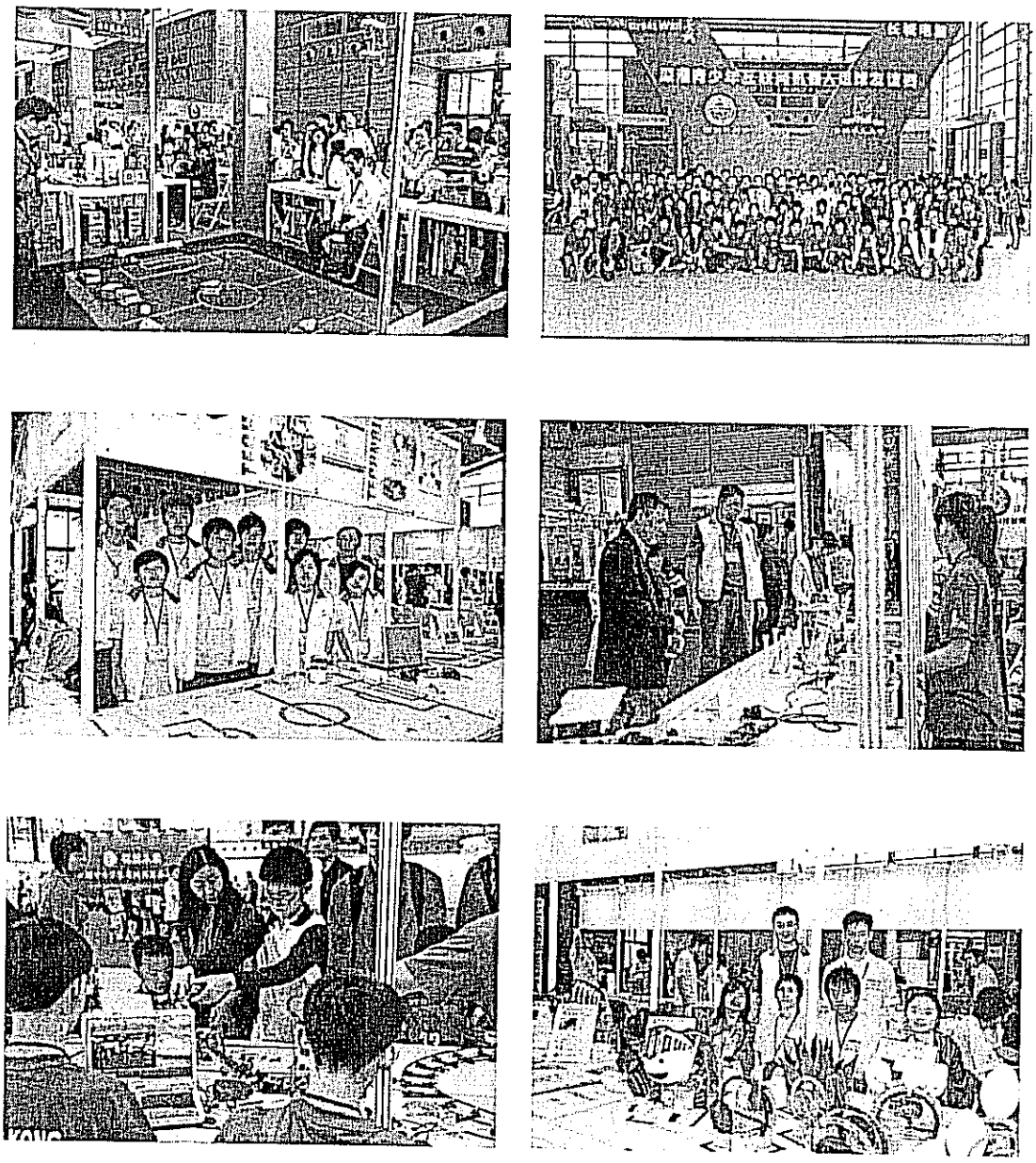

Fig. 8 Reports and snapshots on Shenshen Exhibition (3)

Appendix II

Justification for the budget

I. Job Duties and qualifications for personnel in part (a)

(i) The Project Coordinator is to coordinate the development and implementation of the project. He/she should have a bachelor degree or above in education or relevant subject. He/she will coordinate the efforts among CUHK and the secondary schools and take care of the implementation, evaluation, etc.

(ii) The Sensor Research Assistant is to help the PI lead the development of Internet resources and supervise the technical teams. His/her role is responsible for designing and developing the software packages for the project. He/she should have a Master or above degree in Mechanical Engineering, or Computer Engineering, and have substantial experiences in developing Internet website, human-friendly interfaces, 3-D simulation tools, 2-D drawing processing and recognition systems, etc.

(iii) One Research Assistant is to develop the enabling software of the Internet resources He/she should have a bachelor degree in information engineering, or mechanical engineering, responsible for developing website and web-based interface.

(iv) One Research Assistant is to develop the enabling software of the education resources He/she should have a bachelor degree in information engineering, or mechanical engineering, responsible for developing the robot design software from components.

II. Details of equipment to be purchased in part (b)

(i) The budget for the web server is to cover the expenses of purchasing a computer server hosting the Internet education resources for design and innovation.

(ii) The budget for software is for purchasing the software package for developing the database, internet and simulation tools.

(iii) The budget for 2D input devices is to purchase 2D input devices such as drawing panels, that enable the students participating in this project to input their 2D drawings. The devices will be distributed to the schools.

(iv) The budget for "computer server for schools & staff" is to purchase client computers for accessing the Internet resources from the supporting schools, and computers for the research staff.

III. Details for General Expenses in part (e)

(i) Publicity cost includes production of banners and posters for the competition and cost for road shows, exhibitions and seminars for on-line resources.

(ii) Training materials: This is to cover the expenses of training materials of the workshops organized for teachers.

(iii) Publication of curriculum materials: This budget is to cover the publication cost of curriculum books, CDROM and others.

(iv) Organization of the competition: This budget is to cover the expenses of organizing the design competitions.

(v) Other expenses: This is to cover the cost of external audit and other expenses that has not yet been taken into account when writing this proposal.