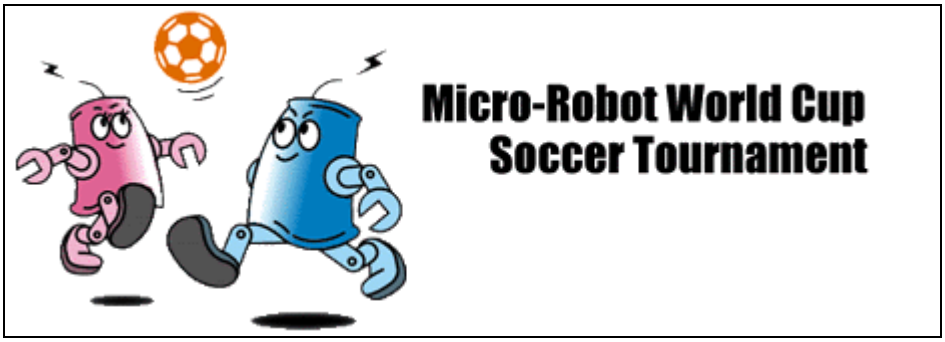
SFU MIROSOT Team ’99

Project Funding Proposal for Ensc370

January 19, 1999



http://www.ensc.sfu.ca/research/mirosot/

SFU MIROSOT Team ‘99 Project Proposal

Submitted by:	SFU MIROSOT Team ‘99
Contact Person:	Arash Haidari-Khabbaz School of Engineering Science, SFU Burnaby, BC V5A 1S6 Telephone: 688-2420 ahaidari@sfu.ca
Submitted to:	Dr. Andrew Rawicz 8849, Applied Sciences Building, SFU Burnaby, BC V5A 1S6
For:	ENSC 370
Date:	January 19, 1999
Revision:	1.01
Proposed Cost:	$2211.69

Signed:

Arash Haidari-Khabbaz

SFU MIROSOT Team'99
SFU Engineering Science
Burnaby, BC V5A 1S6
(604) 688 - 2420

January 19, 1999

Dr. Andrew Rawicz
School of Engineering
Simon Fraser University
Burnaby, BC V5A 1S6

Re: Funding Proposal for Ensc370 and SFU MIROSOT Team'99

Dear Dr. Rawicz,

The enclosed document is the project budget proposal for the SFU MIROSOT Team'99. Due to your kind and generous contribution in the past, the SFU MIROSOT Team was able to make substantial progress towards the goal of winning the MIROSOT 1999 and 2000 World Cups.

May we please inform you that SFU will most likely host the MIROSOT 1999 World Cup Qualifying Games. Our appearance, as a strong team, will not only make SFU known worldwide but will also attract many students to our school. Furthermore, we are hoping to use this opportunity to gain the attention of different industries and the military to our project.

This year we are attempting to improve the robots by using additional hardware and software that will be designed and implemented onboard the robots to meet our objectives. Our proposed budget is $2211.69. We are again seeking your support and hope you will contribute fully or partially to the total amount.

Should you require further information, please feel free to contact our team representative, Arash Haidari-Khabbaz (e-mail: ***ahaidari@sfu.ca***). You may also contact our project faculty advisor, Chao Cheng (e-mail: ***chao@sfu.ca***). For more information on our project, please visit the SFU MIROSOT home page at ***http://www.ensc.sfu.ca/research/mirosot.***

Thank you in anticipation of your kind attention to this matter.

Sincerely yours,

Arash Haidari-Khabbaz

Enclosure: Project Proposal for Ensc370 and SFU MIROSOT Team'99

Executive Summary

The Micro Robot Soccer Tournament (MIROSOT) is an international robotics competition in which teams of robotic soccer players compete against one another. One of the aims of the competition is to promote developments in autonomous robots and intelligent systems that can cooperate as a team to achieve a mutual goal.

The SFU MIROSOT Group (SFMG) is researching, designing and constructing a robot soccer team that will compete according to the rules outlined in the MIROSOT Rule Book ***(http://www.fira.net/fira/index.html).*** The SFU MIROSOT Team '99 (SFMT '99) is attempting to redesign the current existing robots to equip them with partial intelligence on board. This will be done through the addition of hardware and software for the purposes of collision avoidance and improved path following characteristics. Our fields of research are robotics, sensors, wireless communication, data processing, feedback control and related areas of engineering and technology. Possible applications include robot teamwork in manufacturing industries, target search, multiple-object sensing, obstacle avoidance and military operations.

We propose to design and construct the first prototype of the semi intelligent robotic soccer players and associated support systems. We plan to complete this task by April 01, 1999, as most of us have at least three years of post secondary education and at least two co-ops of industrial experience.

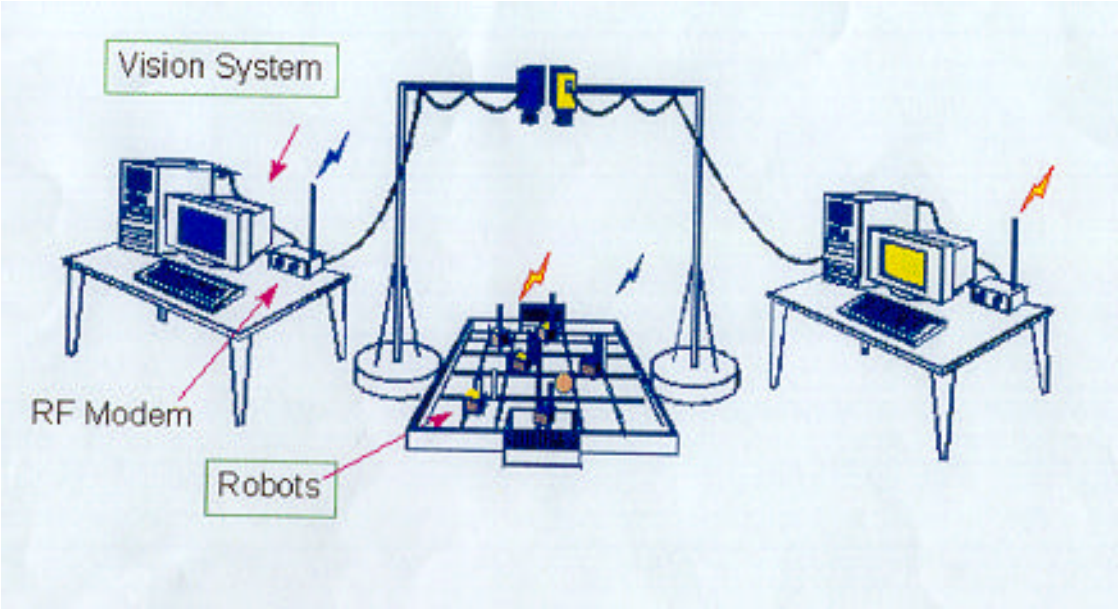
The SFMT '99 proposed system, outlined hereafter, will cost approximately $2200 to construct which is about one-third the price of solutions proposed by other international teams.

Table of Contents

Background

The SFU MIROSOT (Micro Robot Soccer Tournament) Group was formed in 1996 to provide ongoing research projects for students and faculty at SFU. Currently, the group consists of 23 undergraduate students and 3 faculty advisors. Originally, the group was known as SFBOT but it was later decided to rename as SFU MIROSOT Team'98 for the year 1998 competition in Paris. This year, SFU MIROSOT Team'99, continues with the researching, designing and constructing a robot soccer team that will compete according to the rules outlined in the MIROSOT Rule Book, ***(http://www.fira.net/fira/index.html)***. A copy of general and the most significant rules can be found in appendix B.

The MIROSOT project involves students participating through team and individual efforts to directly link the project with engineering science courses, projects and thesis. The following is a picture indicating how different systems in a fully functional MIROSOT team interact and communicate with each other.



The Competition

The MIROSOT is an international robotics competition, which pits teams of robotic soccer players against one another. Each team consists of three robots (maximum dimensions of 7.5 cm x 7.5 cm x 7.5 cm), which can only communicate with their "coach" computer through wireless communication. The robot's positions are fed to the "coach" computer through the use of a camera mounted above the playing surface. The purpose of the "coach" computer is to determine the movements for each of the robotic soccer players. For further information, please visit our home page at ***http://www.ensc.sfu.ca/research/mirosot/.***

The Goal: Olympics, 2000 (Australia)

Every year, the competition is held in conjunction with major events around the world. In year 2000, the competition will be held in conjunction with the Olympics in Australia. In year 2002, the competition will be held in Korea along with the World Cup of Soccer.

This year, the 1999 qualifying competition may be held at Simon Fraser University in Canada and qualifications for the Brazil and Australia Olympics will be determined. The 1999 World Cup is to be held in Brazil. We are planning to have a team prepared for all the competitions. Our appearance in these games is going to attract lots of attention to our school and to our team members and to our sponsors.

With continuing support from our sponsors and continuous hard work of our team, we feel confident that our team can achieve the above goals.

Project Goals

Some of our goals for this project are to:

- Promote Simon Fraser University and establish ties with other universities worldwide and within Canada, while attracting some good students in the process.
- Apply the skills that we learned through our education and gain more practical experiences.
- Use robot soccer to introduce people to engineering and technology, hopefully attract some undergraduates.
- Establish industrial contacts.
- Develop and test new methods for autonomously controlling a team of robots.

Most the goals outlined above were met during our participation at the competition this year in France.

Benefits to SFU

We had a lot of support from SFU last year but we would really like SFU to support us better as most of the cash funding came from industry last year. As a result of the industrial funding, names of our sponsors were mentioned along with SFU, an act that caused disagreements among some parties at SFU. The following are some of the benefits that SFU will have by supporting us:

- Promotion of SFU worldwide that will hopefully attract new graduates to SFU from other universities.
- Provide on going research for students at SFU engineering school and any related studies.
- Future ENSC 351/385 course work along with already present Ensc370 course work. Also special project courses and thesis work for undergraduates.
- Robot system demonstrations at the SFU open house and at Science Alive that will hopefully attract new undergraduate students to SFU.

- Our team, the SFU MIROSOT team will be better known.
- International and local SFU promotion thorough MIROSOT booklets and newsletters.
- And other means of promoting SFU as they evolve.

Applications of MIROSOT Technology

The following are some applications of the MIROSOT technology:

- Real time data communication and mobile communication.
- Real time autonomous control. (QNX Inc. had invited us to promote our QNX software and control programs for one of their trade shows).
- Cooperative teamwork among robots to achieve a mutual goal (e.g. mining and manufacturing).
- Exploration and actions in manned and unmanned environments (e.g. Mars exploration using a team of robots).
- Multiple-object tracking and target search for machine vision (machine vision is a complex problem that still lacks a simple solution).
- Educational robotics applications (At this time, we are looking at possible ENSC351 course work within the next two years).

SFU MIROSOT TEAM ’99 Description

The following is a short description of the members of the SFMT ’99. Our resumes, attached as appendix A, describe our expertise in detail.

Heidi Lam	Software Engineer Software designing, testing and implementation
Arash Haidari-Khabbaz	Hardware Engineer Hardware designing, testing and implementation
Shankar Kamath	Hardware Engineer Feedback control, analog/digital design
Craig Hennessey	Hardware / Software Engineer Feedback control, embedded system programming, PCB layout.

Budget Proposal for the SFU MIROSOT Team'99

Currently, the MIROSOT team is constructing robotic soccer players and associated support systems for MIROSOT World Cup'2000. We plan to complete this task by June 01, 1999. The cost of the robotic system will be approximately $9000. The MIROSOT team expects about half the cost to be covered by industrial funds and donations. The remaining half will hopefully come from the School of Engineering Science, the VP Research, Dean of Applied Science, Director of School of Engineering Science, Director of Centre for Systems Science, and by Dr. Andrew Rawicz.

Technical Budget (for Robots only)

We noted during the competition that all other teams (except for us and the team from the UK) were using the so called "highly sophisticated" Korean made robots which are sold at retail price of over ***CAD$1650 each***. However, we feel that's we can build equally competitive or even better robots for less than half the price.

Since we are implementing new hardware onboard the robots and the fact that we only have a 7.5 cm cube to fit all the hardware, we will have to redesign the robots and it is a possibility that we may even require to redesign the chassis. Thus in most cases we find it impossible to use components and circuits from MIROSOT 98 system; however, for any design we will check to see whether or not we can reuse parts from last year's deliverables. Our projected expenses for the robots are listed below, and are expected to be covered primarily through industrial and school sponsorships/donations:

Robot Hardware:

Item	**Price**	**Source (Approximate price)**
Miniature Motors	45.48	Imported from Korea
Miniature Encoders	290.00	Not used last year
Batteries	0	Donated ($80 over 6 month use of robots)
Receiver	67.51	Covered through sponsorship last year
Printed Circuit Boards (PCBs)	57.60	
Custom made Chassis & Wheels	0	Covered through Sponsorship ($210)
Electronics (µC, H-bridge, misc.)	72.00	Mostly donated except µCs and H-bridges

Other Hardware:

Item	**Price**	**Source (Approximate price)**
Five Computers (NT, Unix, QNX)	0	Donated ($7000)
2 Transmitters	81.33	Covered through sponsorship last year
PIC Development Kit	0	Covered already ($213.45)

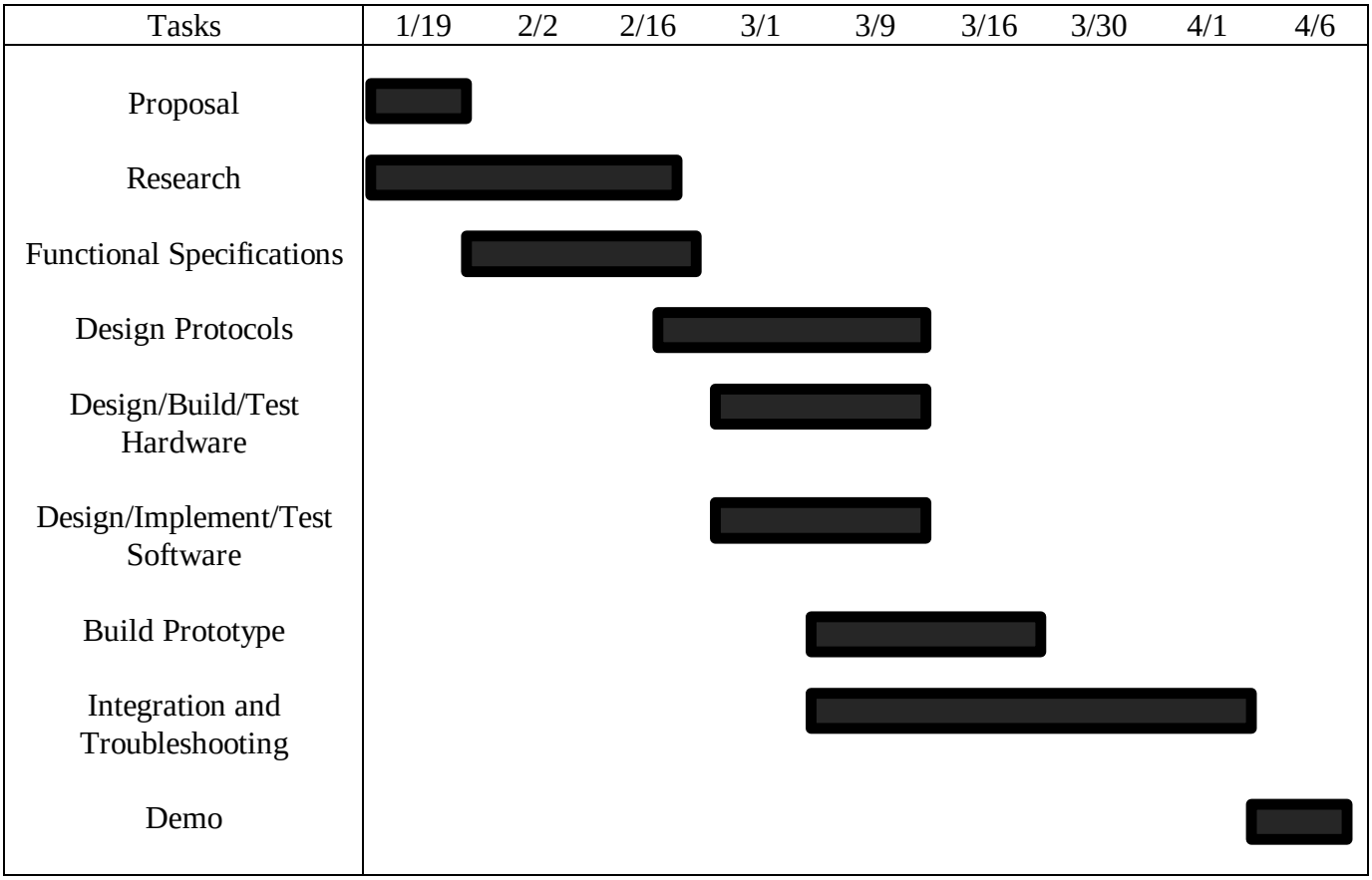
Totals:

4 robots @ 532.59each	2130.36
Other hardware	81.33
Total	**2211.69**

Budget Request = $2211.69CDN

Gantt Chart

The following is a rough sketch of our timing schedule. Please note that the gantt chart is just rough estimation and it may change to meet the project requirements.



Project Milestones

Jan 19, 1999	• Present Project Proposal
Feb 2, 1999	• Progress Report
Feb 16, 1999	• Functional specifications finalized
Feb 30, 1999	• Sourced all parts
Mar 9, 1999	• Finish design specifications
Mar 16, 1999	• Finish building
Apr 30, 1999	• Finish testing
Apr 6, 1999	• Finish Process Report and Demonstrations

CONCLUSION

This document has outlined our proposed technical solution to solve the MIROSOT technical problems concerning collision avoidance and path following. Our expected cost for the building four robots is approximately $2200. It is to be noted that during the 1998 competition all other teams (except for us and the team from the UK) were using the so called "highly sophisticated" Korean made robots which are sold at retail price of over ***CAD$1650 each***. However, we feel that we can build equally competitive or even better robots for about one-third the price. Our expenses can be further reduced through industrial donations. The redesigned robot will be ready for demonstration by April 01, 1999.

At the same time we are hoping to have a strong appearance in the 1999 qualifying games that we will most likely host. With your kind help we are hoping to attract researchers and professionals as well as new students to our school.

We are again seeking your support and hope you will contribute fully or partially to the total amount. We appreciate your kind consideration because your support will be a determining factor in our quest for success. At least 23 SFU engineering students will benefit by working on the project and gaining new experience. The benefits also extend to students enrolled in Ens370, hopefully Ensc351 in future, and special project courses.

We thank you in advance for your support for the SFU MIROSOT Team'99. We will work hard to meet our goals. We are really committed to winning the competition this time and your support definitely increases our chances of meeting our goals.

For further information please feel free to e-mail our team representative, Arash Haidari-Khabbaz at (e-mail: ***ahaidari@sfu.ca***) or you can also contact our faculty project advisor Chao Cheng at (604) 291-3820 (e-mail: ***chao@sfu.ca***).

APPENDIX A

RESUMES

This appendix contains the resumes of MIROSOT Team’99 members. This is a detailed description of our experiences, qualifications and skills.

ARASH HAIDARI-KHABBAZ
1504-1020 Harwood Street
Vancouver, BC V6E 4R1
Tel.: (604) 688-2420
E-mail : ahaidari@sfu.ca

EMPLOYMENT

Jan 1998-
May 1998

Design Engineer, NORTEL, Ottawa, ON
Developed test methods, designed test circuits and used them to test and verify the **Optical Carrier-48 Demultiplexer** card's **ASIC**s, **BUS**es and **transmission lines** performances. Responsible for designing and verifying the system improvements. Responsible for assisting the ASIC design team in verifying the timing margins for their new ASICs.

Nov 1996-
Apr 1997

Executive Assistant (Part time) , Progrex Consulting, Surrey, BC
Developed software in **dBase** and **C++** for a building security system. Located companies and negotiated the specifications and hardware for the system.

May 1996-
Aug 1996

Industrial Consultant Assistant, ALL-Motechnics Co.
Technical Consulting Department, Tehran, Iran
Addressed the customer's inquiries about large scale **industrial control systems** for cement plants and rolling mill industries with the manufacturer. Also discussed the technical problems, advantages, and disadvantages of the customer's design with respect to available technology, and prepared an estimate for the customer.

May 1995-
Aug 1995

Production Engineer, Nira Co. LTD., Maintenance Department
Tehran, Iran
Responsible for maintaining, installing, and testing circuit boards for digital central telephone systems. Provided training for the production line's new employees. Responsible for modifying the **power supply** board design using PROTEL.

SKILLS

Hardware:

- Familiar with Micro electronic fabrication
- Experienced in Circuit design and RF circuit design
- Competent with variety of lab equipment such as oscilloscopes, function generators, FFT digital analyzer, spectrum analyzer, and delay boxes
- Experienced in assembling circuit boards.

Software:

- Competent in **C/C++, Turbo Pascal, dBase**
- Familiar with **DSP, VHDL, PLC, FPGA** and **Micro Controller** programming
- Experienced in **MATLAB, PSPICE, PROTEL** and **MaxPlus2**
- Familiar with **DOS, UNIX, QNX,** and **WINDOWS** environments.

Other:

- Mechanical Drafting
- Flying a C-172 aircraft (Student pilot license)
- Fluent in Persian and familiar with middle eastern cultures

PROJECTS

Micro Robot Soccer Tournament (MIROSOT), SFU, Burnaby, BC
Elected by MIROSOT management to lead the Robot group for ENSC 370 project. The group is responsible for implementing optical encoders and redesigning the robots.

Aircraft Flat Tire Detector, SFU, Burnaby, BC
The objective is to make the pilot aware of having a flat tire during flight.

Telescope Shutter System, SFU, Burnaby, BC
The objective is to develop a plane of 2048 x 2048 shutters using surface mount micro machining. Each shutter is 100 microns square.

EDUCATION

May 1997- Present	**Simon Fraser University, Burnaby, BC, Canada** Fourth year Engineering Science Electronics option
Oct 1996- Apr 1997	**CompuCollege School of Business, Burnaby, BC, Canada** Computer Programming and System Analysis Graduate
Sept 1994- May 1996	**Sharif University of Technology, Tehran, IRAN** Second year Electrical Engineering

AWARDS

1998- 1999	Semesters 98-2, 98-3 and 99-1 SFU open undergraduate scholarship Semester 98-3 SFU Alumni scholarship
1994	Sharif University Entrance Scholarship. The scholarship was given to students ranked in the **top 1%** of applicants in the university entrance exam.

INTERESTS

Electronics	Designing electrical circuits and assembling circuit boards.
Computers	Image processing, writing software, learning to work with different computer languages and object oriented programming.
Sports	Skiing, tennis, soccer, basketball, and kung fu
Other	Playing electronics keyboard, skydiving, and flying.

CRAIG HENNESSEY

chenness@sfu.ca
6077 140th Street
Surrey, B.C. V3X 1E1
Tel: Voice (604) 594-2993

EDUCATION

Sep 1996 - Present	Simon Fraser University, Burnaby, B.C. Third Year Engineering Science Undergraduate Systems Option
Jun 1996	Tamanawis Secondary School, Surrey, B.C. Graduated with Top Honours
Jan 1996 - Mar 1996	Course in 3D-Studio animation software
Oct 1994 - Dec 1994	Introductory course on industrial robotics, BCIT

EMPLOYMENT

Sep 1998 - Jan 1999	**Junior Hardware Engineer, Scientific Atlanta Burnaby, B.C.** Assisted Senior Engineers in various tasks pertaining to releasing a new product such as building test jigs and component replacement (surface mount). Researched new HDTV standards.
Jan 1998 - May 1998	**Test Software Developer, Newbridge Networks Burnaby, B.C.** Implemented test procedures for a new feature on the Newbridge MainStreetXpress 36170 MultiServices Switch using the TCL script language.
Jul 1997 - Sep 1997	**Research Assistant, Simon Fraser University, Burnaby, B.C.** Mapped Virtual-University web page to help in predicting student activity. Annotated CZ-web videos for usability factors. Evaluated communication tools for use with the Virtual-U.

PUBLICATIONS

Feb 1999	**GPS World Magazine** Authored article on GPS used in the International Aerial Robotics Competition.

SKILLS

Software

- Programming experience in C, C++, Java, TCL.
- Basic HTML and JavaScript
- Competent with Word, Excel, Maple, Adobe PhotoShop, many Internet software packages.
- AutoCAD 12, and CAD packages for circuit design and

	digital hardware design such as LogicWorks and MicroSim PSPICE.
Operating Systems	Windows - Win 3.11, Win 98, Win NT Unix - Linux, Sun/Solaris Real-Time - QNX, Pharlap ETS MAC OS
Hardware	• Networking experience with Windows 98 • Familiar with most electronics lab equipment, such as DMMs, power supplies, function generators, analog and digital oscilloscopes, spectrum and network analyzers.

AWARDS

Sep 1996 and Jan 1997	Both installments of SFU Summit Scholarship
Jun 1996	Provincial Scholarship Tamanawis Wildcat Bursary Tamanawis Top All Round Student Award Jostens Academic Excellence Award

VOLUNTEER

Jan 1999 - Present	MicroRobot Soccer Group member - Team competes in international robotics competition using robots to play soccer. Working on encoder feedback and embedded software.
Jan 1998 - Present	Arial Research Group member - Team placed first in the 1998 Arial Robotics competition. Worked on the real time control system, GPS, sensors and actuators. Currently working on the new airship design.
Sep 1996 - May 1997	Science Alive - Promote science to elementary school children through presentations.

INTERESTS

Electronics	Have built a number of devices: • Power supply, diode laser, programmer for a PIC chip microprocessor. • Designed an analog to digital converter board and interfaced it with a PC. Using this board I have built a digital oscilloscope.
Music	Currently taking guitar lessons. Previously taken three years of drum lessons.
Sports	Soccer, mountain biking, sailing, and skiing,

GEETA KAMATH

#3-3562 E. 49TH AVE.
VANCOUVER, BC V5S 1M4
(604) 431-0420

PROFILE: I have recently completed a six week temporary contract in Calgary, AB where I taught **French Immersion Mathematics**. During my teacher's training, I did my extended practicum at **Pinetree Secondary School** (Coquitlam, BC) in the **Science** Department. Since being exposed to the demographics of the Pinetree student population, I am interested in the **ESL programme** in your school district. I enjoyed watching my students grow both academically and intellectually in my classes. I am prepared to bring interest and enthusiasm into my classroom and foster a love of learning for all my students.

EDUCATION:

September 1997- Aug 1998
University of British Columbia
Vancouver, BC

Bachelor of Education
Secondary Programme
Concentration: Sciences

September 1992- December 1996
Simon Fraser University
Burnaby, BC

Bachelor of Science Programme
Biology Major
Environmental Toxicology Minor

SPECIAL SKILLS:

- Fluency in the French language (graduated with a bilingual Dogwood Diploma)
- Extensive experience teaching Secondary Math and Science
- Basic Computer Skills
  MS Word (6.0), MS Works, HyperCard, Excel, Kaleidagraph, Turbo Pascal, Minitab
- Experienced in various laboratory skills (biological and chemical)
- Radiation Safety Training Certificate (March 1996)
- St. John's Ambulance First Aid- CPR included (May 1997)

WORK EXPERIENCE

Sept 1998-present
Coquitlam School District
Coquitlam, BC

TEACHER ON CALL

Duties:
*Teach a varied number of subjects for children of all ages

October 1998-December 1998
Western Canada High School
Calgary, AB

TEACHER

Duties:
*Taught French Immersion Math 20 (11), Math 10 Honours, Math 13

May 1997- Aug. 1997
Collacutt Luggage, Metrotown
Burnaby, BC

SALES REPRESENTATIVE

Duties:
* Handled cash during customer purchases

May 1993- Aug. 1993
La Federation des Franco-
phones de la Colombie
Britannique (F. F. C. B.)
Vancouver, BC

RECEPTIONIST/ DATA BASE ENTRY

Duties:
* Worked in an office atmosphere as a receptionist at the front desk

VOLUNTEER EXPERIENCE

Oct. 1996- Dec. 1996
Ecole Mary Hill
Coquitlam, BC

TEACHER ASSISTANT

Duties:
* Assisted children, in a French Immersion class, aged 9-10 yrs with Math, English and French

Sept. 1996- Dec. 1996
Ecole Anne Hebert
Vancouver, BC

SCIENCE COUNSELOR
La Service de Garde Letourneau

Duties:
* Initiated activities related to Science for a French after-school day care for children aged 5- 10 yrs.

June 1996. Aug. 1996
Simon Fraser University
Burnaby, BC

SCIENCE COUNSELOR
Science Alive!

Duties:
* Assisted instructors with hands-on science programmes for children aged 8- 13 yrs

April 1996 and April 1994- June 1994
Merritt Secondary School
Merritt, BC

TEACHER ASSISTANT

Duties:
* Prepared a French Immersion class for debates and oral components of the provincial Francais 12 exam for youth aged 13- 18 yrs

June 1994- Aug. 1994
Pahadi School for Children
Bombay, India

CHILD CARE SUPERVISOR

Duties:
* Familiarised young children aged 2- 6 yrs with the English language in a day care setting

Heidi Lap Mun Lam

575 West 64th Avenue
Vancouver, BC, Canada V6P 2L1
(604) 327-6680
Email: hllam@sfu.ca

EDUCATION

Sept 97 - Candidate for Bachelor of Applied Science

Present **Systems Option, Biomedical Engineering Stream**
Simon Fraser University

WORKING EXPERIENCE

Jan 98 - Junior Application Developer, Nortel, Toronto ON

Apr 98

Designed and demonstrated a methodology to efficiently analyze and convert an existing application built for a specific customer into a generic, flexible package that can be used alone or as part of another application.
Assisted in the development of a team function library by contributing two functions written in C.
Acquired working knowledge of IVR Application Processor, Unix, C and Visual C++, Oracle/SQL.

Apr 96 - Medical Clerk, Medical Oncology, Ontario Cancer Foundation,

Jun 96 Civic Hospital, Ottawa ON

Performed preliminary examination of outpatients in the Lung and Breast Cancer Clinics.
Complied and prioritized data collected from patients and presented to supervisor in a time sensitive environment.
Completed the data collection and preliminary analysis of a clinical study on Inflammatory Breast Cancer.

May 90 - Research Student, Analytical Chemistry, UBC, Vancouver BC

Aug 90 **Developed a quantitative method for lead detection utilizing Flow Injection Analysis, this project was adopted as a course laboratory exercise at UBC.**

SKILLS SUMMARY

Hardware
- Working experience in Unix, Windows 3.1/95/NT, Mac O/S
- Currently working on project courses involving digital and analog design

Software
- Experienced with most word processing, spreadsheet and drawing/drafting software including Maple, AutoCAD, Oracle/SQL

Language
- OOP, SmallTalk, C, C++, VHDL, HC12 and MPASM

Others
- Competent with basic lab equipment such as oscilloscopes, DMMs, power supplies and function generators
- Familiar with ergonomics and human factor design
- Completed project course in mechanical design
- Able to produce quality work under time pressure
- Excellent interpersonal and communication skills
- Fluent in English and Chinese

GENERAL INTERESTS AND ACTIVITIES

Music
- **Obtained the Licentiate Performer Certificate for Pianoforte from the Trinity College of Music, London, England in May 1996**
- Interested in sound synthesis and the development of digital pianos

Volunteer
- Served at the Cancer Information Line to answer questions from the general public regarding cancer

Others

- **Enjoy reading a wide variety of literature**
- Enjoy travelling, favourite cities include London, Oxford, Vienna, Salzburg, Boston, Ottawa and Vancouver

APPENDIX B

Rules of MIROSOT

The following is just a summary of some general and most important MIROSOT rules. For complete detail of MIROSOT rules please refer to ***(http://www.fira.net/fira/index.html)***

Law 1 The Field and Ball

(a) Dimensions

A dark green, wooden rectangular playground (130 cm x 90 cm) with 5 cm high white side walls, will be used. The surface texture of the board will be that of a ping pong table.

(b) Markings on the playground

The field of play shall be marked as shown in Figure 1. The half-line and the goal lines will be marked by lines of 3 mm thickness. On the field, dark grid lines of 1mm thickness will be marked at every 1cm. The centre circle will have a radius of 10cm. An arc (20cm along the goal line and 5cm in perpendicular to goal area) shall be used for the goal kick. The major lines/arcs (centre line, goal area border lines, centre circle, arc just in the from of goal area) will be marked with 3mm white lines. The four corners of the table will be chopped off (by 7 cm), to avoid the ball getting cornered.

(c) The Goal

The goal shall be 35 cm wide. Posts or nets shall not be used at the goal for the vision system.

(d) The Goal Area

The goal area shall be 60cm X 15 cm in front of the goal.

(e) The Ball

An orange golf ball shall be used as the ball (with diameter 42.7 mm, weight 46 g).

(f) The Field Location

The field shall be indoor.

(g) The Lighting Condition

The lighting condition in the competition site shall be fixed around 1,000 Lux.

Law 2: Players

(a) Overall System

A match shall be played by two teams, each consisting of three robots, one of which can be the goalkeeper (See (b)(2) of Law 2). Three human team members, the "manager", the "coach" and the "trainer" shall only be allowed on the stage. One host

computer per team, mainly dedicated to vision processing and other location identifying, can be used.

(b) The Robots

(1) The size of each robot shall be limited to 7.5 cm x 7.5 cm x 7.5 cm. The height of the antenna will not be considered in deciding a robot's size.

(i) The tops of the robots must not be colored in orange, dark green or in white. The Robot teams can be distinguished by the assigned color (blue or yellow) patches. All the robots must have a 3.5 cm x 3.5 cm solid square region of their team color patch (exactly as provided by the organizers) visible on their tops. Please note that, a team's color might change from game to game, so the color patches should be removable (See Appendix 4). When assigned with one of the 2 team colors, the robots must not have any visible color patches of that of the opponent team.

(ii) The sides of the robots should be colored with light colors, except at regions necessarily used for the robot functionality (such as sensors, wheels and ball catching regions). The siding is intended to enable infrared sensing. The robot should have their uniforms and its size shall be limited to 8 cm x 8 cm x 8 cm.

(2) The robot inside its own goal area shall be considered as the "goalkeeper." The goalkeeper robot shall be allowed to catch or hold the ball only within its own goal area.

(3) Each robot must be fully independent, with powering and motoring mechanisms self-contained. Only wireless communication shall be allowed for any kind of interactions between the host computer and the robot.

(4) The robots are allowed to be equipped with arms, legs, etc., but they must meet the size restrictions even with the appendages fully expanded. None of the robots, except the single designated goalkeeper shall be allowed to catch or hold the ball such that more than 30 % of its diameter will not be out of the view either from the top or from the sides. The ball should never be lifted off the ground.

(5) Any time the referee whistles, all robots should be stopped by using the communication between the robots and the host computer.

(c) Substitutions

Three substitutes shall be permitted during the game in progress. At half time, unlimited substitutions can be made. When a substitution is desired while the game is in progress, the concerned team manager should call 'time-out' to notify the referee, who will stop the game at an appropriate moment. The game will get restarted, with all the robots and the ball placed at the respective positions, as were occupying at the time of interrupting the game.

(d) Time-Out

The team managers can call for 'time-out' to notify the referee. The referee should have to approve these requests in cases of fouls, free balls, etc. Each team will be entitled to requesting for time-out, twice in a game and each shall be for a duration of 2 minutes.

Law 3: Transmissible Information

The manager, the coach or the trainer may transmit certain commands directly from the remote host computer to their robots. Commands, such as, reset signals to stop all robots or the restart signal can be transmitted during play. Other strategy informations, etc. can be communicated only when the game is not in progress. The manager, the coach or the trainer under no circumstances, directly control the motion of their robots either with a joystick or by keyboard commands. The host computer can send any information during a game, autonomously.

Law 4: Vision System

Vision system can be used. The location of camera or any other sensor systems should be restricted to the top of the area above their own half of the field including the center line (so that the camera need not be moved at halftime). Should both teams want to put their cameras over the center circle, they will be placed side by side at equal distance from the center and as close as possible. The height of the camera or the sensor system should be higher than or at the least equal to 2 m, above the field.