POOL SHARK TECHNOLOGIES
Simon Fraser University
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September 25, 2000

Dr. Andrew Rawicz
School of Engineering Science
Simon Fraser University
Burnaby, British Columbia
V5A 1S6

Re: ENSC 340 Project Proposal for the Ace Training System

Dear Dr. Rawicz:

The attached document, Proposal for the Ace Training System (ATS), introduces our project objective for ENSC 340 (Engineering Science Project). Our objective is to design and develop a virtual snooker coach that teaches the player how to properly hit the balls into the pocket, while developing essential skills such as cue speed and aiming.

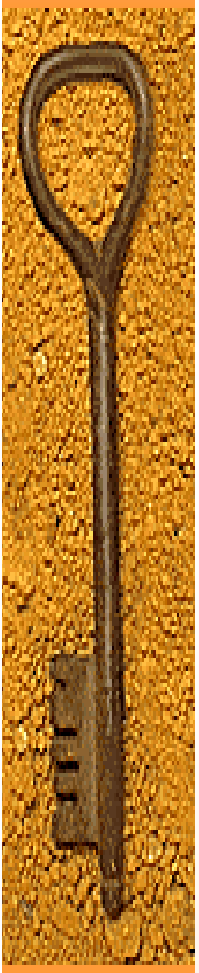
This proposal provides an overview of the ATS, an outline of possible design solutions, a tentative plan for funding, budget, and scheduling, and a detailed explanation of our team organization and structure.

Pool Shark Technologies consists of five talented and ambitious 4th engineering students: Desmond Cheung, Humphrey Ng, Patrick Pun, Janice Wong, and Lawrence Wong. If you have any questions or concerns, please feel free to contact Humphrey Ng by phone at 431-6333 or by email at hngc@sfu.ca.

Sincerely,

Janice Wong
Team Leader
Pool Shark Technologies

Enclosure: ENSC 340 Project Proposal for the Ace Training System



Project Proposal for

Ace Training System

Team: **Desmond Cheung**
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Issued date: **September 25th, 2000**

Revision: **1.0**

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Executive Summary

Snooker and billiards are two of the most popular recreational games in the world. Here in Canada and in the United States, many leagues and associations exist in which amateur and professional players compete in various 8-ball tournaments[1]. As a case in point, the American Poolplayers Association presently has over 170,000 members. In Europe, the names of snooker champions such as Stephen Hendry, Jimmy White, and Steve Davis are as recognizable as the likes of Michael Jordan, Tiger Woods, and Mark McGwire here in North America. The popularity of the game is enormous: millions of viewers tune in each week to televised matches involving the game's top players. In addition, the World Professional Billiards and Snooker Association is currently taking steps to promote the game to youths[2].

Pool Shark Technologies is taking advantage of this vast and growing market by creating the *Ace Training System (ATS)*, a virtual coach that teaches players to play the game like true professionals. Using its precise image processing ability, the ATS will be able to survey the playing surface before instructing the player on the best ball to hit, as well as where and how to hit the ball. From the reliable guidance of the ATS, the player will develop a strong strategic sense in how to play the game. Of course, the ATS will also help the player to improve and perfect essential striking skills such as cue positioning, aiming, cue speed, and follow through. Thus, this system is suitable for every kind of player, whether he or she is a beginner learning the game for the first time, or a professional trying to perfect his or her skills.

Pool Shark Technologies consists of five enthusiastic and hard-working 4th year SFU Engineering students with a wide variety of hardware and software skills. We believe strongly in the ATS, the first of such in the market. This product will be thoroughly researched, developed, and tested by the target date of December 2000. The budget for the development of the ATS is estimated to cost $1160.

[1] Taken from http://www.dmoz.org/Sports/Billiards/Associations_and_Leagues/ 2000
[2] Taken from http://www.sky.com/sports/snooker/feature2.htm 2000

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Introduction

The game of snooker is widely played throughout the world. Its origin can be traced back to the 17th century, when pool halls were already immensely popular in Europe's large cities and small towns [3]. Snooker has been and still is one of the most popular sports at all time.

In the General Household Survey of 1990 conducted in Britain, snooker was proved to be one of the most popular played sports, ranking second most popular for men and fifth for women. In 1997, an independent survey showed that for the British national television network BBC's coverage of the 1996 World Snooker Championship, a total of 40 million of Britain's current 54 million population watched, with viewing figures peaking at 8.9 million and 9.8 million at the latter stages of the tournament [4].

In North America, the popularity of snooker is not as titanic as compared to Europe. However, North Americans are more familiar to the game derived from snooker – billiards, also known as pool. The two games differ by the size of their playing surface and their basic rules. The objective of these games, nevertheless, remains the same: to hit the ball into the pocket.

To capture the enormous global market, Pool Shark Technologies is developing the *Ace Training System (ATS)* that teaches how to best play the games of snooker and pool. The product is being created by five enthusiastic engineering students from Simon Fraser University, who all have a very keen interest in the games of snooker and pool.

This document is a proposal providing an overview of the ATS, a brief system overview, and some design options and considerations. Budget, sources of funding, team organization structure, as well as our preliminary timeline for the project also are included.

[3] Taken from The Global Snooker Center. http://website.lineone.net/~janiew/history_001c.htm 2000
[4] Taken from The Snooker Sponsorship Company. http://www.snookersponsorship.com/corporate.htm 2000.

Background on Pool and Snooker

The games of snooker and pool have the same origin. In this section, the similarities and differences between the two games are discussed.

Pool, sometimes called pocket billiards, is the most popular style of play in North America. A pool table is smaller than a snooker table (50 by 100 inch) and has six pockets. The most widely played versions are 8-ball and 9-ball. In 8-ball, the two players must hit all the balls with the distinct pattern, either solid or strip, before hitting the black ball (the "8-ball") to win the game. In the game of 9-ball, nine numbered balls are used. The cue ball must contact the lowest-numbered ball first; if it does and any ball is pocketed, the shooter gets another turn. Whoever pockets all nine balls wins. Figure 1 shows the different dimensions and the different styles of play between pool and snooker.[5]

The typical snooker table is 2 by 4 m (6 by 12 ft) and has six narrow pockets with rounded openings. Twenty-two balls are used: 15 red balls, 6 balls numbered from 2 to 7, and 1 cue ball. Players score points by pocketing reds and numbered balls alternately. When pocketed, reds remain out of play, while pocketed numbered balls are returned to the table to assigned spots. When the reds are gone, the numbered balls are pocketed in numerical order (refer to Figure 1). Points are also scored when the opponent fails to hit balls in the proper sequence.

Aside from the dimension of the table and the goal of the different games, pool and snooker are games that test one universal skill. That is, to use the cue ball to hit the target into the pocket. This skill can be perfected using the ATS, which is described in the following section.

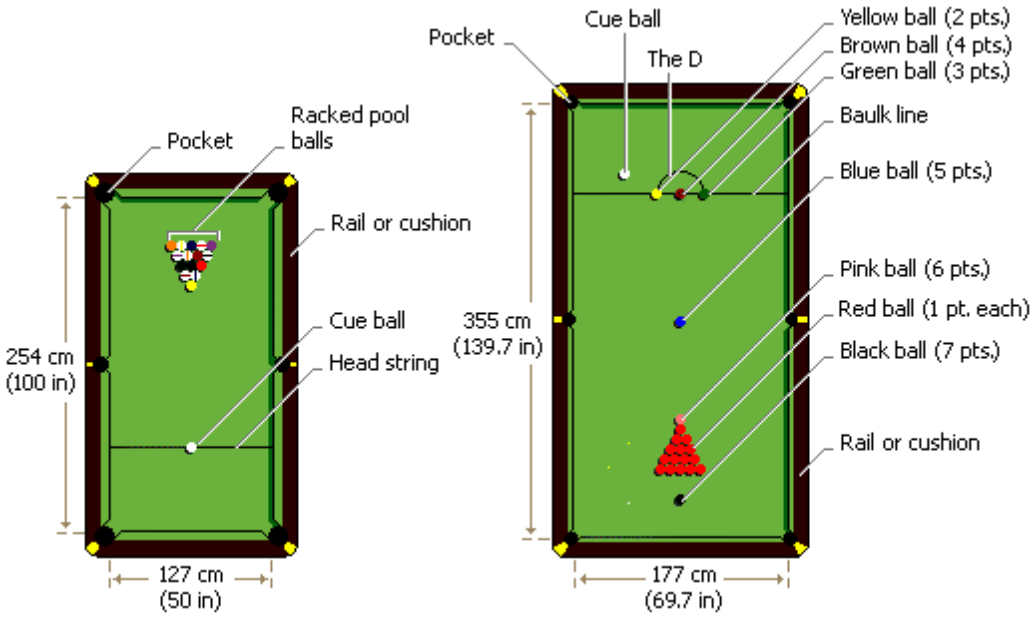

Figure 1: General Information on Pool and Snooker

[5] Taken from Microsoft Encarta. http://www.encarta.com 2000.

System Overview

For both snooker and pool, the Ace Training System (ATS) helps users to hit most appropriate target ball into the pocket depending on their location and colour.

Figure 2 illustrates the system overview for the ATS.

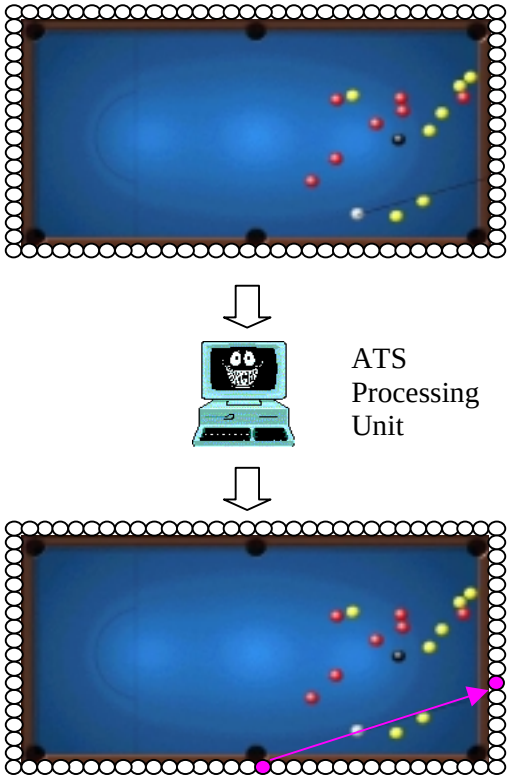

Figure 2: High Level Pictorial System Overview

First the system uses sensors to detect the location of the balls and to identify the colours of the balls. This information, along with the type of game being selected, is then processed in the ATS Processing Unit to determine the best target ball to hit. To guide the users to make the best possible shot, the system lights up the indicators located around the pool table, which forms an imaginary straight line between the cue ball and the intended location to hit. A more detailed system flow chart is shown in Figure 3.

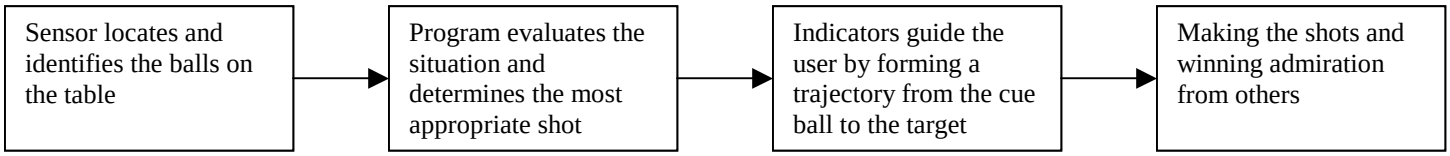

Figure 3: System Flow Chart

Possible Design Solutions

In order to detect the position of the balls on the table, we need to employ the use of sensors. There are basically two main categories of sensors that are considered to sense the position of the balls on the table. Sensors can be either embedded inside/under, or over the top of the table. Although using embedded sensors eliminates the extra hardware mounted outside the table, external hardware is more economical. The following are the sensors that have been considered:

Tactile Sensor
Tactile sensor is the most accurate sensor among all the alternatives. Tactile sensor is usually used on robot arm and is used to sense the shape, temperature, material, and location of an object. There are a few types of tactile sensors; each one based on different theories including mechanical, optical, and semiconductor.

CCD Camera
Either a digital camera or a video camera can be used to capture an image. This image is then processed by image processing software. Image processing software can do color recognition, 2D/3D positioning, and shape recognition. Since the balls being detected and the table that they are sitting on are well-defined objects, simple software algorithm can be created or obtained easily.

Touch Pad Sensor
Touch pad sensor is widely used in computer equipment. Laptop computers use touch pad as a mouse device; graphics designers use touch pad as a writing/drawing device. Based on the difference in capacitance on a certain area, the position of an object can be detected.

Ultrasound Sensor
Ultrasound sensor is considered as a clean and easy option. Ultrasound positioning is used extensively in many other fields. However, ultrasound is not a good candidate here as its performance is easily affected by temperature, surrounding objects, and other external factors.

Solution Chosen

Among the above solutions, tactile sensor provides the most accurate locationing. However, as these sensors are highly delicate, they are very expensive and thus not feasible to use for the product. Touch pad sensors are not as delicate, but they are also expensive.

CCD Camera is chosen as the solution. There are a few advantages:
- Commercial CCD cameras can be obtained easily
- No extra assembly is needed for embedding hardware inside the table
- Cost efficient
- Color recognition and position sensing all in one
- Commercial image processing software available

Sources of Information

During the initial stages of our project, we consulted various sources of information for the best method to developing the ATS. We received a great deal of useful advice from professors and lab instructors with different fields of technical expertise. These experts included Dr. Albert Leung, Dr. Andrew Rawicz, Mr. George Austin, and Mr. Lucky One, to name a few. At the same time, we utilized the vast amount of information on the Internet to expand our knowledge about different types of sensors, digital cameras, and market potential of the ATS.

In developing our proposed solution, we will be using various reference and data books, textbooks, research papers, and material from previous courses to enhance our knowledge of essential topics such as image processing, microcontrollers, and user interfaces. As well, we will continue to seek help from members of faculty who have experience in these areas.

Budget and Funding

Table 1 illustrates the estimated cost for our project. The figures will need to be enhanced by about 10% to cover any contingencies. In addition, we believe some companies will be interested in our project and will be willing to donate some of the necessary parts and thus lowering our budget.

Equipment Name	Cost
Processor	$30
Evaluation board	$300
RAM	$30
Camera	$400
Pool table (2nd hand)	$200
Balls and cues	$50
Miscellaneous (light bulbs, wires etc.)	$150
Total	**$1160**

Table 1: Forecasted material costs

To finance this project, we will be applying to student project funds in addition to soliciting funds from various billiard and gaming organizations. We plan to apply for the Wighton Engineering Development Fund, which is a fund administered by members of the Simon Fraser Engineering faculty for the purpose of funding student projects. We also plan to apply for the Engineering Undergraduate Student Society Endowment Fund, which is another fund administered for the purpose of funding student projects. Finally, we will be looking into Dufferin Games Ltd. and various gaming organizations to provide funding for our project.

To save cost, we will try to acquire free parts from manufactures such as Motorola and other local companies. Any additional funding required to complete the project will be contributed equally by each group member. We are confident that we will receive from these various sources the necessary funding to complete this project.

Scheduling

Figure 4 shows the Gantt chart and Figure 5 shows the milestone chart of our project. These target dates have been thoroughly discussed and planned. We are confident that we will meet these deadlines and produce the deliverables upon the proposed date.

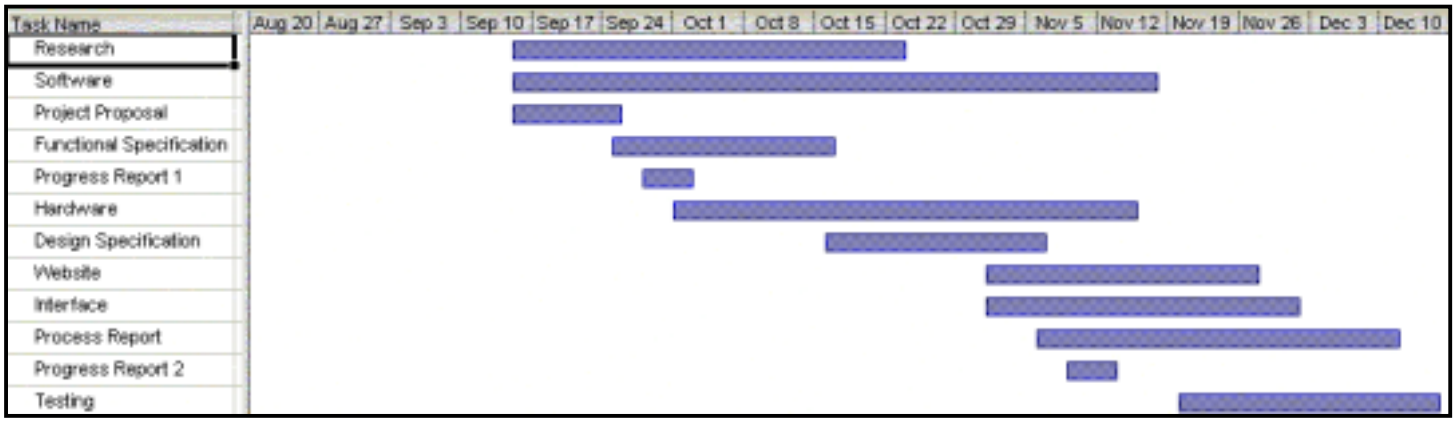

Figure 4: Gantt chart

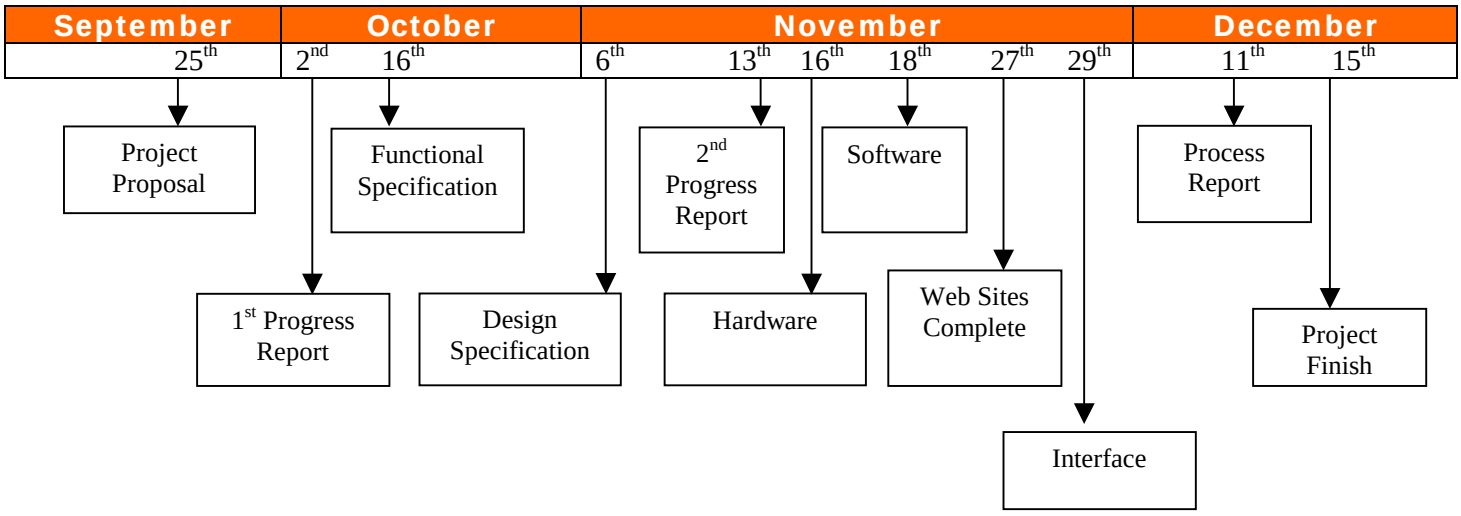

Figure 5: Proposed milestones completion dates

Group Dynamics

The team at Pool Shark Technologies consists of five enthusiastic and hard working 4th year Engineering students. We understand that in order to obtain the best result from everyone on the team, we need to operate in a manner that ensures regular mutual communication and assistance from each other. We realize that it is very important for everyone on the team to be in touch with the progress of all the aspects of the project, and not simply be confined to their own tasks.

Aside from the regular updates and inquiries through emails and telephone calls, we have set up regular meetings on Monday and Thursdays of each week. In these meetings we will discuss the "to do" list for the next few days and any problems encountered, review recent progress, and make any major decisions that has been brought up prior to the meeting.

Although everyone on the team will eventually participate in all aspects of the project, we will each have an area of concentration. The hardware team consists of Desmond Cheung, Humphrey Ng, and Patrick Pun, all of whom have had previous experiences with microcontrollers and hardware interfacing. The software team includes Desmond Cheung, Janice Wong, and Lawrence Wong, all with plenty of programming skills from past projects or courses. Janice and Patrick will be in charge of the marketing aspect of the project. Janice is our team leader, and she will be responsible for heading our meetings and overlooking the entire project.

There is not a great deal of hierarchy in the Pool Shark team. We feel that we will work best under this structure, under which the lines of communication is always open and available. The following will be a closer look at the qualifications of each team member.

Profiles

Desmond Cheung is a 4th year Computer Engineering student at Simon Fraser University. He had co-op experiences in Sierra Wireless Inc., ICBC, and Cogent Chipware Inc. His work mainly lay on software developing, particularly with C/C++. Through course work, he has also worked on few projects involving Motorola's M68HC11 microprocessor and its assembly language. Beside software, he is skillful in mechanical hardware and enjoys any hardware works.

Humphrey Ng is a 4th year Systems Engineering Student. He has been working in Motorola as Software Engineer for the DataTAC two-way messaging system and GPRS network. His work with the Odyssey of the Mind creative project – Balloonacy Car team in 1997 has received provincial Ranatra Fusca Award for being the most creative project in B.C. Humphrey has also been involved with founding the Casa Student Association in SFU, and is an active member of the student club.

Patrick Pun is age 21, and he serves as a member of the Hardware and Financial/Marketing Team, and serves as a director. Patrick is currently working towards his bachelor's degree in Computer Engineering at Simon Fraser University. While working at MDSI in Richmond in 1999 as an implementation engineer, Patrick honed his creative design skills and flourishes in an innovative environment. The job also gave him exposure towards project management developed his interest towards its related financial responsibilities. Patrick is a founding member of Pool Shark Technology and provides invaluable hardware design expertise.

Janice Wong is a fourth year Computing Engineering student at Simon Fraser University. Through the academic years at SFU and previous coop work terms, she has gained a variety of experience in both hardware and software, and has developed teamwork and problem solving skill. Some of her areas of strength are software such as C++, Visual Basic and Assembly. In addition, she has also improved her marketing and interpersonal skills by participating in many extra-curricular activities and by being the Director of Public Relations of a Chinese student club at SFU.

Lawrence Wong is a 4th year Computer Engineering student at Simon Fraser University. At his previous work-term at Creo Products Inc., as well as in the courses he took, he has had plenty of experiences in both software and hardware. His various project experiences include: writing a Windows NT kernel driver, creating games and simulation devices using microcontroller, and configuring FPGAs and CPLDs. As well, he has taken courses in microelectronics circuit theory, real-time and embedded systems, and software engineering in general. He is very excited to work on this fun and innovative idea with a group of students who he enjoys working with.

Conclusion

Pool Shark Technologies is dedicated to implement the latest technology to enhance the age-old game of snooker and pool. Our current project, the Ace Training System, is expected to generate enormous interests to millions of pool enthusiasts around the globe. By guiding the users to make the best appropriate shot, learning to play pool is very easy.

The system overview of our design briefly describes how the Ace Training System works. We also identified our sources of technical and financial information that will propel us to achieve our product. According to our Gantt chart and milestone chart, we are confident that by Christmas 2000, a prototype of our product will be ready for evaluation.