I. Introduction

Since the late 1970s, people around the world have been able to play darts using computerized, plastic dartboards. In stark contrast to traditional bristle-type ("cork") dartboards with metal-tip darts, these electronic versions use lighter plastic soft-tip darts. These soft-tip sets free the player from keeping score by hand on a chalkboard, but at a price: the plastic darts frequently bounce off of the board. When the darts do stick, the tip is often damaged. In severe cases, the ends of the tips break off inside the board. Despite these significant drawbacks, many consumers settle for soft-tip sets due to the convenience of the electronic scoring. What if the convenience of the soft-tip electronic boards could be combined with the excellent game play characteristics of a bristle-type board?

II. Technical Description

We propose a computerized bristle-type dartboard, for use with metal-tipped darts, allowing the thrill of real darts with the convenience of automated scoring. Our dartboard consists of a standard bristle-type board encircled by a device that detects the location of the darts. Connected to the dart-locator by a cable is a processing and scoring apparatus, from which the current game statistics, such as score and current player, are displayed.

The dart location determination device (Fig. 1) operates on the principle of triangulation. Three laser beams sweep the dartboard by reflecting from rotating mirrors. The mirrors that will be used are polygonal scanning mirrors, similar to those found in a common laser printer, thus allowing precise control over the mirror position, and precise knowledge of the direction of the reflected laser beam. Sensors around the board sense the beams of light. When a dart comes onto the board, each beam of light will be interrupted at a point in its sweep of the board. Blocked by the dart, the light will not contact the light sensor for a brief amount of time. The supporting electronics detect the lack of light and note the position of the mirror, generating a vector to the dart. When the three beams finish sweeping the board, there will be three vectors,

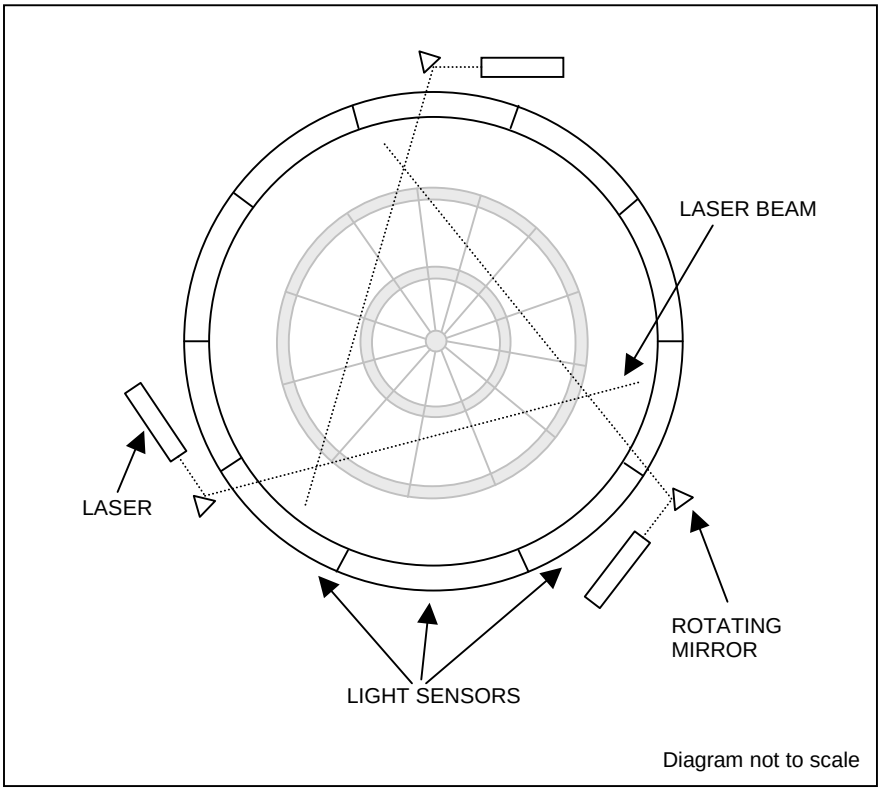

Figure 1: Position Determination

one from each laser, to each dart on the board. Each triplet of vectors intersects at a single location, that being the location of a dart. Finally, microcontrollers translate the intersection points into game scores and display the score as appropriate on the display. Appendix A contains foreseeable risks and our contingency plan for dealing with these risks.

III. Market Potential

According to Sports Business Research Network (SBRN) there are approximately 19.6 million Americans who play darts. Roughly 60% of these people are males between the ages of 12 and 44, with the Midwest being the most popular dart-playing region. SBRN also shows this to be the age group in which dart throwing interest is piqued and pursued before waning in the mid forties. A somewhat deeper analysis shows that 4.0 million people are classified as frequent dart-throwing participants (playing 30+ days per year). Our efforts will be concentrated on reaching these frequent participants, as they would be the people more apt to buy a premium dartboard. Additionally, we will target business executives in the hopes of keeping up their interests in the game by marketing the product as somewhat of a novelty item similar to the putting greens that many executives have in their offices. Also, by targeting the younger people within our market, we hope to obtain loyal lifelong customers who are more open to changes than their older dart throwing counterparts. Thus, our target market would be the 4 million regular dart throwers, but by using clever marketing strategies to reach people of varying demographics, we will be able to effectively obtain a larger portion of the market share, thereby increasing our overall sales.

Our main competitors are Halex and Sportcraft, both of whom make electronic plastic dartboards[1]. Together, they sell approximately one million boards in a year. Electronic boards sell for $25-$250 depending on the quality and number of features desired. Also, lower-end dartboards do not have "micro-thin" separators. These separators are what help to reduce bounce out in higher end boards. A typical bristle-type dartboard sells for $30-$80, with the higher-end boards in this category having wooden cabinets. One of our design goals is to produce a product that will sell within the $150-$250 price range. If you multiply our target market size of about 4 million people by our target price of about $200, it is easy to see that we have a huge potential market size comprising about $800 million. A more realistic number shows that there are about 1.4 million metal-tip dart sets purchased each year. Using this number we come up with a market size of $280 million.

The secondary data for our product is promising, however there is no substitute for primary data when determining market potential. Since we are located in the Midwest, we have a large portion of the market available to tap into. Our team has sought out dart-playing enthusiasts in order to obtain their perspective on our product. We interviewed these people, and all of them were enthusiastic about our product. When asked what they would be willing to pay, nearly all of our interviewees mentioned a price in the $150-$250 range. Thus, we have customers who are open to our idea and willing to pay a premium price for a premium product.

A preliminary patent search shows one potential patent that we must work around. The patent pertains to a device made by Laser Score[2] , and an abstract to this patent can be found in Appendix B. Justification as to why our technology does not infringe upon this patent can also be found in Appendix B.

[1] www.sbrnet.com

[2] www.crowsdarts.com/reviews/laser.html

Laser Score is currently the only commercially viable competitor in the electronic bristle-type dartboard market, however this product is quite heavy (32 pounds) and bulky. Its high cost (approximately $500) restricts purchase to the affluent dart player. Despite these weaknesses, the Laser Score device received rave reviews from a number of dart-player websites. Says Crow's Darts of the device, "This is really cool." We plan on our device being less expensive and more compact, thanks to an innovative technique of dart location detection. These improvements will be accomplished with no degradation in dart locating accuracy, a critical requirement for any electronic dartboard.

In order to ensure that we have a complete market analysis, we plan to work with a marketing team from the Kelley School of Business at Indiana University in Bloomington, Indiana. By working with a team whose expertise lies in marketing, we will be able to draw upon strengths that the members of our original team do not possess. Through understanding where our strengths and weaknesses lie early on in the development process, we will be able to better ensure the success of our endeavor.

We have chosen to not explore restaurants and bars as a potential market because of the inherent risk involved in metal-tip darts in this environment. Because of safety issues, bars are often limited to the soft-tip darts. Therefore, for the time being we are going to limit our target market to private consumers, but the bar/restaurant arena is a market that we could research and possibly pursue in the future.

IV. Business Model

We considered three distinct business models. The first is to manufacture and market the electronically scoring bristle-type dartboards ourselves. This could involve outsourcing the manufacturing to a local business or even to a foreign producer. It may also involve hiring new personnel with marketing experience. The second model is to manufacture the dartboards ourselves and outsource the marketing to another company, preferably a company already in the gaming market. The final model we considered was to develop the product ourselves, obtain a patent to help protect our intellectual property, then license the technology to a company, possibly even a competitor, for manufacturing and marketing.

Our target distribution channels would consist of two distinct paths. The first would be to sell the product through large retail outlets, such as Wal-Mart and K-Mart, as well as through sports and recreation retailers. This would serve as sales for a large market of potential buyers, specifically the serious dart enthusiasts. Our second channel would be in upperclass chains, such as Sharper Image and Brookstone. This would target the novelty buyers such as business executives.

After reviewing the three models, we concluded that licensing the technology to another company would be in the best interest of our team and all those involved. We believe manufacturing and marketing the product is outside our fields of expertise. In addition, should any lawsuits arise, we may be financially unable to properly defend the product and the company. Marketing may also be an issue, as the two big competitors in electronically scored soft-tip plastic dartboards (Halex and Sportcraft) already have a firm hold on many of the distribution channels. It is unknown what the competitors reaction might be if our product entered the marketplace. They may attempt to prevent our superior product from entering the market by threatening retailers or by blocking marketing and distribution channels. They may also use their wealth advantage to hinder our progress by filing frivolous lawsuits. For these reasons, we believe it is in our best interests to license our product to Halex or Sportcraft. Since Halex and Sportcraft are in direct competition, they are in constant battle to have a superior product. We believe licensing our electronically

scored bristle-type dartboards to them would give them this advantage. Therefore, the two companies should have a significant desire to obtain licensing to our technology.

As a team, our goal is to create an electronically scored bristle-type dartboard for the serious dart enthusiasts and also to market it as a novelty item for business executives, thus tapping into markets that are currently not very well developed. Our primary interests lie in the design, testing, and development of working prototypes. Our short-term goal is to have a working prototype of our project finished within a 28-week time frame beginning September 2003. We plan to have the first prototype completed my March 2004. Our long-term plan is to patent our device and license the technology to an outside company for manufacturing and marketing. We foresee the completion of our long-term goal, extending past our 28-week project time frame, thus extending our project past our college graduation date. We have provided a contingency plan for what we will do if licensing is unavailable in Appendix A.

V. E-Team Members and Skills

Comprehensive resumes for each e-team member are located in Appendix C.

XXX
- Rose-Hulman Institute of Technology, Electrical and Computer Engineering Undergraduate

XXX has experience in logic design and hardware programming. In addition, he has skills in software programming and has also worked with some LCD display programming.

XXX
– Rose-Hulman Institute of Technology, Electrical Engineering Undergraduate

XXX possesses talents in electronics design, programming, and implementation. Through technical internships, XXX is adept at analyzing requirements and implementing them in an effective, efficient manner.

Andrew Orlowski - Rose-Hulman Institute of Technology, Computer Engineering Undergraduate

XXX is familiar with digital and analog circuit design, programming Xilinx chips using Verilog, and software code such as Java, HTML, and C++. He will use his background in programming along with an understanding of hardware to help implement the user interface.

XXX
- Rose-Hulman Institute of Technology, Electrical Engineering Undergraduate

XXX has experience in both digital and analog circuit design. Her primary interests lie in digital design. XXX has also worked as a technical marketing intern for a major corporation, which provides valuable insight to the business aspect of our project.

Dr. Keith Hoover (Technical Advisor) – Rose-Hulman Institute of Technology, Professor of Electrical and Computer Engineering, ECE Department

Dr. Hoover has agreed to be our technical advisor. His areas of expertise include microcomputers and digital system interfacing. He is also particularly active in student project work. We have chosen him to be our advisor not only because he is in our area of study's department and most of us have already worked with him before, but we also feel he can be a valuable resource with his specialization in digital and microcomputer systems and electromagnetics. A letter of recommendation from Dr. Hoover can be found in Appendix D.

VI. Project Budget

Laboratory Equipment	
Digital Oscilloscope	RHIT
Digital Multimeter	RHIT
Power Supply	RHIT
Signal Generator	RHIT
Logic Probes	RHIT
Electrical Parts	
Optics (e.g. lenses and mirrors)	$700.00
Diode Lasers (12 @ $15 each)	$180.00
Light Sensors (30 @ $10 each)	$300.00
PICs (12 @ $6 each)	$80.00
LCD Display (3 @ $200 each)	$600.00
Miscellaneous (e.g. resistors)	$300.00
Mechanical Parts	
Bristle Dartboards (3 @ $80 each)	$250.00
Darts (6 darts @ $15 each)	$100.00
Housing (3 @ $60)	$200.00
Services	
Telephone Services	RHIT
Copying Services	RHIT
Computing Services	RHIT
Office Space	RHIT
Patent Search	$600.00
Patent Related Legal Expenses	RHIT
Detailed Market Analysis	RHIT
Provisional Patent Application	$1,600.00
Contingency (~15%)	$740.00
Total	$5650.00

Line item justification for the budget is in Appendix E.

VII. Work Plan and Timeline

A list of deliverables can be found in Appendix F.

This project will be completed during the 2003 – 2004 school year; therefore the schedule is based upon the Rose-Hulman academic calendar. We allotted 26 weeks for the design and prototyping of our project. The remaining time in our 28 week time frame will be spent on completing documentation, ensuring that the system makes no patent infringements and completing any necessary deliverables. A detailed work schedule can be found in Appendix G.