

**I PRO 306: Researching the Design a Wheelchair
Basketball Computer Game (Avoidatrak)**

Final Report for Summer 2004

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Project Abstract

A Summer 2003 EnPRO team after reviewing the work done by previous IPRO teams and listening to wishes of both Professor Ladenson and Mr. Julius Jones, Jr., a Chicago independent inventor, decided that the Avoidatrak IPRO needed a new and fixed direction. That direction was that the collision avoidance game should incorporate a positive depiction of the abilities of disabled individuals in the form of a wheelchair basketball computer game.

The purpose of this Summer 2004 IPRO was to do preliminary research and discover useful contacts for a Fall IPRO to begin designing Avoidatrak. Specifically, our goal was to generate a document that might be useful to the Fall IPRO team in understanding what the Avoidatrak game should and should not contain.

In order to accomplish this goal, the IPRO team divided itself into two preliminary teams. Team 1 focused on the organizational and meaning that the game should incorporate, namely focusing on what disabled basketball players thought of the game and ways to make it an appealing and uplifting experience. Focus was also placed on the structure of the game, i.e. the level it is played at (locally, nationwide, international). Team 2 focused primarily on the actual game rules, strategies, and technicalities. Part of the research required was to discover what things set apart wheelchair basketball from able-bodied basketball. A consequence of coming up with rules and game play was that team 2 also contemplated various methods of interacting with the game through standard and widely available controllers.

Background on Project

Avoidatrak first appeared on the IPRO list in 1998 as *Opportunities in Assistive Technology*. Inventor and entrepreneur, Julius Jones, Jr., conceived the idea of a toy that would help train disabled people, especially children, how to use motorized wheelchairs. This idea was prompted as a result of an accident that confined Mr. Jones to a wheelchair for an extended length of time.

Mr. Jones received a design patent for his idea but lacked the resources needed to produce a prototype, which was essential for product development. He later discovered the IPRO projects at the Illinois Institute of Technology. Thomas Jacobins, coordinator of IPRO, placed the Assistive Technology project on the list where it was idle for a year until Dr. Robert Ladenson, a humanities professor, forged ahead with it in 1998. Three semesters later, it evolved from a toy design to a computer simulation

game called Avoidatrak. After a very rudimentary interface was created by an IPRO group in the fall of 2002, the project was then handed over to the Summer 2003 IPRO.

This group was supposed to determine if it was economically feasible to proceed with Avoidatrak and create a business plan; but found such tasks difficult. After discussions with Mr. Jones it was realized that his vision of Avoidatrak included either a gaming console, to compete with such systems as Xbox® or Playstation®, or a game that could play on these systems. The summer 2003 IPRO after researching the amount of capital and work necessary to proceed with any of these options decided that a standard computer game would be more practical. After discussing the matter with several individuals involved in adaptive sports and in the video game design industry, the team concluded that implementing a wheelchair basketball computer game would be the best plan to pursue in order to achieve Julius Jones's goal.

Project Team

Director: Dr. Robert Ladenson

Students:

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8. Tiffany N. Lomax (3rd Year, CAE)
9. Elmarie J. Gula (5th Year, ARCH)
10. Calvin Moy (4th Year, MBB)
11. Alex Budiman (4th Year, MBB)
12. Nicholas Jones (4th Year, CS)
13. Jessica Kelley (4th Year, PSYC)

- ORGANIZATION AND MEANING -

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- Organization -

The current plan is to incorporate wheelchair basketball teams from the international playing field as opposed to national, collegiate, local, etc. This will be done to maximize the target audience and to create awareness and appreciation on a global level. Similar to the National Basketball Association, there exists an organization that supports and organizes the playing of wheelchair basketball in all nations. This organization is known as the International Wheelchair Basketball Federation (IWBF).

The purpose of the International Wheelchair Basketball Federation is to provide opportunities worldwide to those who are disabled. The IWBF aims to attain its goal by adopting several initiatives. First, the federation seeks to establish the Official Wheelchair Basketball Rules, the Official Wheelchair Basketball Classification Handbook, the specifications for equipment and facilities, and the Internal Regulations to ensure a standardized playing field worldwide. It also attempts to regulate the transfer of players from one country to another. In addition to playing field regulation, the IWBF raises funds, collects fees, accepts contributions and subsidies, and ensures that all resources are used solely to further its aims and objectives. The final goal of the International Wheelchair Basketball Federation is to implement an organized marketing program that involves communication, public relations, and demonstration events to instill awareness to the general public of the benefits of wheelchair basketball.

Competitive Leagues

The IWBF groups each team into one of four zones depending on location. The current members of the Afro-Arab zone are Algeria, Bahrain, Cameroon, Eritrea, Egypt, Gabon, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Nigeria, Oman, Qatar, Saudi Arabia, South Africa, United Arab Emirates, and Zimbabwe.

The Americas Zone consists of Argentina, Brazil, Canada, Chile, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Honduras, Jamaica, Mexico, Panama, Peru, Puerto Rico, United States, and Venezuela.

In the Asia-Oceania zone, there are Australia, China, Japan, Korea, Malaysia, New Zealand, Papua New Guinea, Philippines, Singapore, Taiwan, and Thailand.

Finally, the Euro zone encompasses Austria, Belgium, Bosnia/Herzegovina, Czech Republic, Croatia, Denmark, Finland, France, Germany, Great Britain, Greece, Ireland, Israel,

Italy, Lithuania, the Netherlands, Poland, Portugal, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, and Ukraine.

What to incorporate into the game

What leagues will be used in Avoidatrak? The best choice for the game appears to be the international leagues. It allows the greatest amount of variation with game scenery and appearance. For example, adopting from multiple nations will allow players to play in front of famous landmarks worldwide, a fact that will help keep the playing field dynamic and captivating. Additionally, the multi-nation aspect causes the game to serve as an educational tool, not only in the sense of wheelchair basketball awareness but also of the multitude of peoples around the world.

How will the players in the game be identified? Currently, acquiring the rights from every player in the IWBF is something that is far out of the financial range of the IPRO. Thus, we have decided to utilize “generic” cartoon faces (as opposed to real photos) to represent the players. However, the IWBF does divide its players into same gender sects. We feel that this will not be necessary in the game. Actually, the incorporation of both sexes will allow the game to appeal to a wider scope, a fact that has always been an underlying goal.

-Meaning and Purpose-

In order to better create a wheelchair basketball computer game it is important for those involved to understand its meaning. This facet includes understanding the significance of wheelchair basketball to players and spectators in order that considerations can be made as to how the characters in the game should be depicted.

Sources

The information for this section was obtained from various sources. The first was the video [Kiss My Wheels](#), which was viewed as an introduction to this IPRO. The film followed a team of adolescents through one of their wheelchair basketball seasons. Through the video, how the game is played was learned. In addition, the video served to show that the players have to face many problems and challenges not seen in able-bodied basketball. The video was also used as insight for the players’ views and feelings about the game. Another source useful for a better understanding of wheelchair basketball was the internet. Although most of the information found online was more relevant to the organizational, structural, and game aspects of wheelchair basketball, the fact that detailed websites exist is important in demonstrating that there is an interest in it; this is necessary for the production of the game to be successful.

A teleconference with players of wheelchair basketball served as a primary source of information for the meaning of the game. The players each had years of experience playing wheelchair basketball, as well as other adaptive sports, and openly spoke about their feelings concerning the game. Finally, other conclusions concerning the meaning and purpose of the game were made through a team effort. Meetings were held regularly to thoroughly discuss

ideas and issues concerning this area of the game, how to understand them, and how they might be implemented into a computer game.

Psychological Aspects

Understanding the meaning that wheelchair basketball has for the spectators and for the players was an important aspect of the research conducted. Wheelchair basketball serves as a recreational opportunity to individuals with varying disabilities. Through the challenges that arise and are overcome in playing wheelchair basketball, it is often a source of confidence and empowerment. The opportunity to be involved with other people that have similar problems also serves as a strong psychological influence. This was supported through the video Kiss My Wheels and by the teleconference with wheelchair basketball players.

In the video, the fact that the players were all young made things more difficult for them because, in addition to their disabilities, they each had to deal with the emotional difficulties associated with adolescence. Several of the players mentioned their annoyance with going to school because of the responses they get from other students. They described playing basketball as a vent for their frustrations and as a sport that allows them to simply enjoy themselves. It is also apparent that they bonded closely with their teammates. One of the key players in the movie became ill and passed away halfway through their season. Watching the team adjust afterward, it was apparent that they really cared for her. However, their strength as a team remained. Overall, the video was useful in that the positive emotional impact that wheelchair basketball can have on young players was learned.

Although the players interviewed were older than those in the video were, the conference also demonstrated many of the psychological effects playing adaptive sports can have. The players each expressed that the social aspect of playing was extremely important. In response to being prompted about how playing wheelchair basketball has affected his life, one of the players, Earl Jordan, said "it helped make contacts with friends... helped build my self-esteem." He further described playing sports as an outlet and a way to get out of the house. Juan Ortiz, who was not very active until he started playing adaptive sports, made similar comments about the interactions with fellow players. Mike Vanclave said of the game that he liked the competition, and the physical and mental exercise it provides. Thus, these players all attribute part of the gratification that comes from playing wheelchair basketball to the social connections they form with teammates.

Based on the video, the teleconference, and upon discussions among the members of the IPRO group, inferences were made about spectators in wheelchair basketball. It is a fair assumption to say that most of the fans of wheelchair basketball are the family and friends of the players. Therefore, their feelings about it involve the improvements they see in the attitudes of the players whom they care about on a personal level. However, other than this, spectators of wheelchair basketball are like those of any other sport. They have a favorite team, sometimes a favorite player, and they go to the games to enjoy themselves.

Purpose

The purpose for making a wheelchair basketball computer game is two-fold: education and enjoyment. Creating such a game would serve to increase awareness and interest in the sport as well as to provide a game that people in wheelchairs can feel good about because of the opportunities it shows that they have despite their disabilities.

There has long been a distance between people with disabilities and those who have none. In order to bridge the any existing gaps, it is necessary to educate able-bodied people and show them that they are not so different from those with disabilities. Although this may seem like an elementary concept, its truth is noticeable in the fact that most people do not know anything about wheelchair basketball or that it even exists. Thus, creating and marketing a wheelchair basketball computer game would serve as an educative tool that would link those in wheelchairs with able-bodied people. Specifically, it would make people aware of the abilities of people in wheelchairs, help lessen the stigma associated with such people, and increase appreciation of adaptive sports.

The aspect of enjoyment associated with a computer game seems more direct, but some might question the need for a wheelchair basketball computer game when so many other basketball computer games already exist. As an example of the significance such a game can have in the lives of people in wheelchairs and their family and friends, consider the following story. Recently, a boy with leukemia requested that there be a game created in which he could destroy cancer cells. With the help of the Make-A-Wish Foundation, his dream became a reality and the game is now played by children like him for motivation as well as entertainment. Similar to the cancer game, a game about wheelchair basketball would provide psychological benefits to those game players who, like the characters, have a disability. Therefore, in addition to being fun for all who would play the computer game, it would more importantly serve as a tool for improved self-image and aspirations for people in wheelchairs.

Medium of Depiction

Most of the information concerning the psychological aspects of wheelchair basketball cannot be implemented into a computer game. Simpler aspects that can be included are those that can be found in other basketball computer games involving responses of characters to plays. For example, some of the characters can make automated comments throughout the game. It is suggested that players or the coach be programmed to respond to plays made by the characters. The sounds the audience makes and the music, if any, can also be important for the game and should be considered.

Suggestions for which attributes to ascribe to the characters for a computer game were based on the research and discussions. Options for the age of the characters ranged from young adolescents to middle aged adults. The benefit of having young characters is that the players of the computer game are likely to be of similar age and could thus better connect with the characters in the game. Having older characters is advantageous in that more popular and skilled wheelchair basketball players fall in this category. Using characters with a range of ages was also a consideration. The recommendation for the computer game is for it to

utilize adult characters. The reason for this is based upon the idea of creating a game that is as realistic as possible. Adult players are likely to have more ability, and would make characters that are more appropriate.

The way the players should look was also considered through a psychological perspective. An option addressed was basing the characters on real players. This would allow people to choose their favorite players, a fact that would make the game more exciting. However, this did not seem reasonable considering that the sport is not popular enough and does not have a significant following. The other option, which was agreed upon as the better choice, is to design various characters with general features that could be customized. As for the gender of the players it is suggested that there be options for teams with all males or females, or both. Decisions concerning characters should be further addressed after considering limitations in programming.

Recommendations from the organization and meaning group

Concentrate on the fact that this game is unique and appealing

- The game should focus less on the one-on-one aspect that able-bodied basketball emphasizes.
- Emphasize defense to make the game more exciting: quick, crisp passing, chair positions.
- Incorporate wheelchair tricks: tilting the wheelchair to make player reach higher, quick twisting turning.

The concept of a wheelchair basketball game is unique and has the potential to become popular beyond the niche market of the wheelchair-bound population. The game should focus less on the one-on-one aspect that able-bodied basketball emphasizes and more on defense. Quick chair movement, crisp passing, chair positions can be made visually pleasing to increase excitement. Wheelchair tricks can also be incorporated in the game, e.g. having the players tilt their wheelchairs to heighten their reach.

Continue interaction with the wheelchair basketball players and coach

- Try to contact spectators to see what they find appealing to watching the game
- Try to find able-bodied players that play with wheelchair basketball players
- Model game players off of real life wheelchair basketball players

Continued interaction with the wheelchair basketball players will provide invaluable information towards the production of a wheelchair basketball game. The players and coaching staff can place future IPRO teams in contact with spectators to see what they find appealing in watching the game. Suggestions from fans can be used to improve aspects of the game that will increase the appeal of the game. Good relations with the wheelchair basketball team from the Rehabilitation Center can place the IPRO in contact with other basketball players from other cities, which would increase the available knowledge base and ultimately work towards producing a commercially viable product. The knowledge of game characters can be modeled accurately by analyzing the physical conditions of wheelchair basketball players. This can lead to game characters possessing attributes, which determine its endurance, shooting and passing accuracy, and defensive ability.

Recommend that the game be set in the international arena

- This increases the appeal of the game and simplifies the formation of teams: ex. United States v. Canada
- This also expands the available pool of players available if the future IPRO teams decide to use real life players.
- The teams begin playing in regional tournaments and as the game progresses play in national tournaments and international tournaments.
- Possibly, incorporate sponsorship into the game. As the team progresses, larger sponsors contribute to the team.

The recommendation of setting the game on the international arena was one that considered the appeal the game would have in the general public and the ease of team formation. Making international tournaments an aspect of the game allows for a clear progression of the game. As the gamer progresses through the local tournaments, the games get harder and the gamer is invited to play on the international level against teams from all over the world. This also simplifies the formation of teams, as there can be as little as one team per city, which would play the teams from other cities. If real life wheelchair-basketball players are incorporated into the game, the number of available players is more numerous on the international level. Future IPRO teams can possibly incorporate sponsorship into the game. As the team progresses, larger sponsors contribute to the team.

Usage of both female and male wheelchair basketball players

- There should be three types of teams: All male, all female, and teams with both male and female characters.
- The game characters should also be able to grow as the game progresses.

There should be three types of teams: All male, all female, and teams with both male and female characters. Having both male and female characters increase the educational value of the game. Awareness of available recreational opportunities is improved when all types of teams are represented in the game. The game characters should also be able to grow as the game progresses. Every game the wheelchair character plays, their experience increases and they receive skill points that can apply to different attributes. This would reflect the improvement in play that actual wheelchair basketball players experience as they play more.

– THE GAME –

Case Cantrell
Vince Catalano
Nicholas Jones
Jessica Kelley
Bachum Mataruke
Ray Powell

In order to actually make Avoidatrak, a wheelchair basketball game, there are certain aspects of the game that have to be researched and included into the game to make it as realistic and as entertaining as possible. The important components of the game can be divided into seven different groups:

- Rules: Every game has to have rules, which all of the players have to follow in order to make the game fair for all teams involved. Failure to abide by these rules leads to penalties incurred. In addition, the rules have to determine how the game is won or lost.
- Strategies: In a team competition, there have to be certain strategies that are used in order to try to achieve victory. There may be certain offensive or defensive formations that allow for scoring points or stopping the opponents from scoring points.
- Players: A wheelchair basketball game will have to have teams consisting of players. Who are these players? What are their ages? Sexes? Body Types? Disabilities?
- Skills: Wheelchair basketball players have to have certain skills in order to be good players. Some of these skills include: ability to move the wheelchair, passing, shooting, etc. Some players may have certain skills and lack others, or have an equal proportion of each.
- Modes of play: A video game has to have different levels of play. Those who are new to the game may have no idea how to play the game and need to learn how to play. Others may be very good at the game and want more of a challenge when they play.
- Sounds: A game needs to have sounds. Some kind of background sound is usually beneficial and sound effects are crucial in a wheelchair basketball game to make it as realistic as possible.
- Interface: Avoidatrak is a video game and, therefore, will need some kind of controller. There are many types of controllers: keypads, joysticks, pressure-sensitive, etc. Each of these has its own benefits and drawbacks.

The aspects of the game included in this report are described and analyzed, but without developing a design for how to implement all of them into a game. This will be the job of the

fall IPRO group. Not all of the aspects of the game can be programmed exactly as they are depicted. These ideas are simply the ideal; some flexibility will be required to make this game become a reality at a college-education programming level.

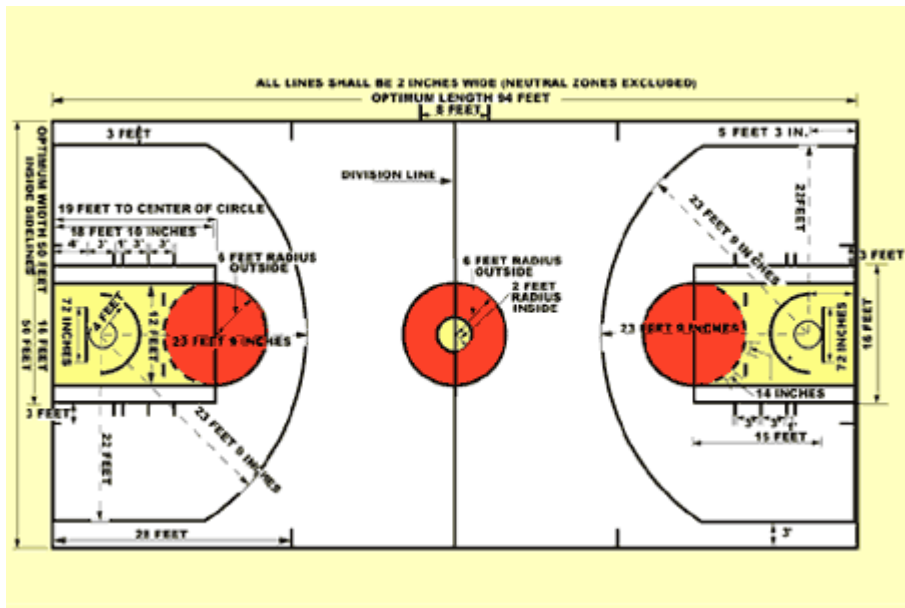
I RULES

This section involves the rules of Avoidatrak including: the equipment, scoring, violations, winning and losing, etc. In addition, there are some notes to the programmers (denoted by *italicized* font) that may be beneficial when trying to design and implement the game. Some of this information was taken from www.nwba.org and some from www.nba.com.

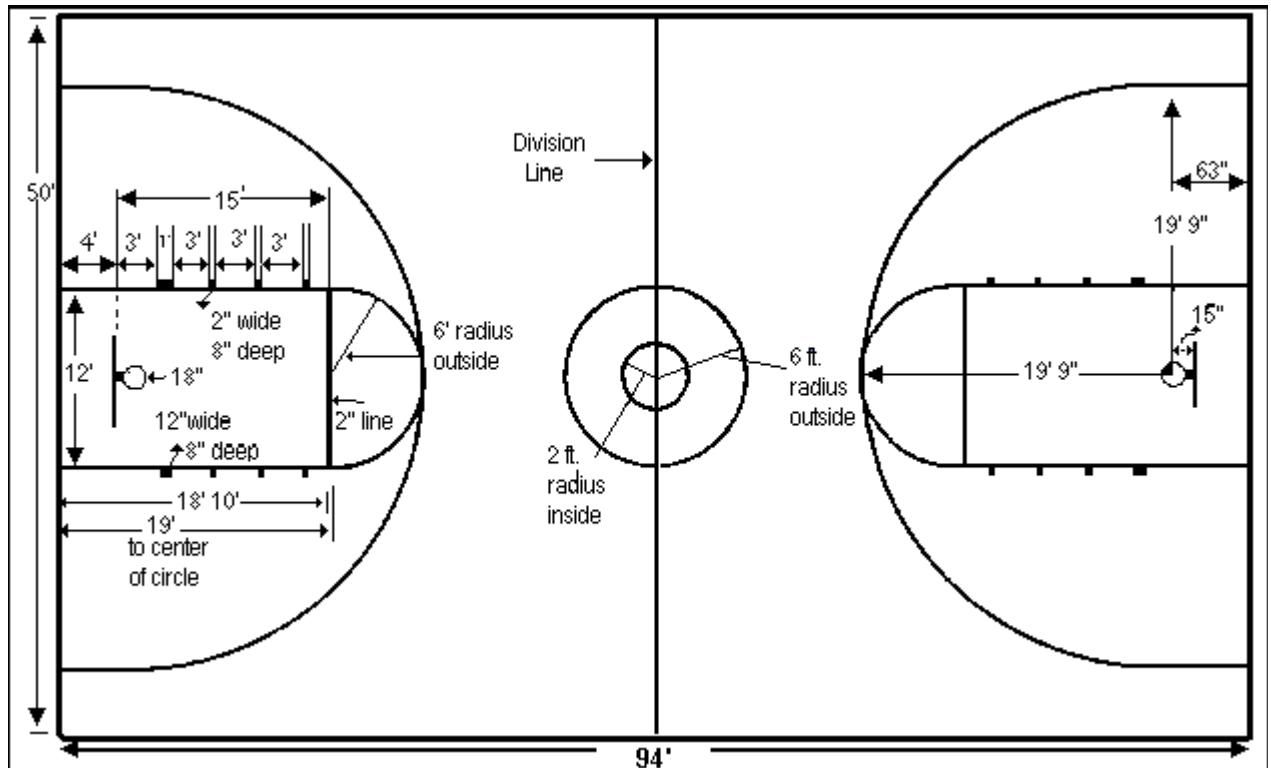
Times

1. There will be four twelve-minute quarters in a standard game. There can also be an option for three-minute or six-minute quarters for gamers who do not have as much free time for a standard game.
2. Each team can be in control of the ball for no more than 24 seconds per possession. The shot clock is reset if the ball touches the controlling team's rim or control is gained by the other team.
3. The team in control has ten seconds to get the ball out of backcourt, i.e. to their side of the court

Court and Equipment



(www.nba.com)



<http://www.handymanusa.com/articles/basketballcourt.html>

4. The court to be played on is rectangular and measures 94' by 50'.
5. The hoop is to be 10' off the court.
6. A free throw lane shall be marked at each end of the court with dimensions and markings as shown on the court diagram. All boundary lines are part of the lane; lane space marks and neutral zone marks are not. The color of the lane space marks and neutral zones shall contrast with the color of the boundary lines. The areas identified by the lane space markings are 2" by 8" inches and the neutral zone marks are 12" by 8". (www.nba.com)
7. A free throw line shall be drawn (2" wide) across each of the circles indicated in the court diagram. It shall be parallel to the end line and shall be 15' from the plane of the face of the backboard. (www.nba.com)
8. The three-point field goal area has parallel lines 3' from the sidelines, extending from the baseline and an arc of 23'9" from the middle of the basket which intersects the parallel lines. (www.nba.com)
9. *Although the aforementioned are the proper measurements, for programming and entertainment purposes, exact measurements should not be required. It is important for, however, proper proportionality in the measurements though.*

10. *The NWBA website gives many specifications about the wheelchairs that are legal in wheelchair basketball. However, in a video game, these specs seem unimportant as long as no wheelchairs have advantages over others. In other words. Only the fact that they are all "built" the same, except color and any other exterior design, is critical for fairness in the game.*
11. *It would be advantageous for the gamers if the wheelchairs of one team were all the same color in order that the different teams could be differentiated.*

The Game

12. Five players for each team are allowed on the floor at a time.
13. The game begins with a jump ball. One player from each team is at half court. The official throws the ball in the air and the players try to tip the other members of their team. The players involved in the jump ball do not try to catch the ball when it is thrown in the air by the official.
14. While the players are moving their wheelchairs with control of the ball, dribbling is required. After maneuvering (pushing, changing directions, pivoting, etc.) their wheelchairs twice, the players have to bounce the ball on the floor (i.e. dribble) a minimum of once. If no movement occurs, no dribbling is required. If moving and no dribbling occur, this is a traveling violation and the other team gains control of the ball from out of bounds. See rule 26 for out of bounds play.
15. *If so desired, dribbling can be automated when the game is developed to minimize work for the gamer. This would also make the programming easier since traveling violations would not be possible. Another option would be for dribbling to be automated for the novice and medium levels, but not for the professional level. This would greatly increase the "work" and control required by the gamer. In addition, traveling violations would have to be incorporated in this level.*
16. If the ball goes off the court, a team is awarded control of the ball if the opposing team touched it last before it went out of bounds. See Rule 26 for out of bounds play.
17. If a player makes a basket from inside the three-point line (23' 9"), two points are awarded to that team. If a player makes a basket from outside the three-point line (23' 9"), three points are awarded to that team. The other team then gains control of the ball from out of bounds. See Rule 26 for out of bounds play. If the basket is not made, the ball is unclaimed and anyone can go after it.
18. Each team is allowed four timeouts per half.

19. If a wheelchair tips over, a player falls out of the wheelchair near the action of the game, or any injury occurs, play stops immediately. The team in control of the ball regains control out of bounds. See Rule 26 for out of bounds play.
20. *It would probably be easy, but not as realistic, to exclude tipping over the wheelchair in this game. If two players directly run into each other, there is definitely going to be some physical contact and possibly tipping over. If it is decided to include these ideas into this game, physics (momentum, friction, etc.) are going to have to be involved to make it realistic.*
21. The official time clock stops anytime play stops: timeouts, personal fouls, injuries, and violations. However, it does not stop when a basket is made in regular play.
22. Substitutions of players can occur only when play has stopped.
23. If the score after four quarters of play is even, a five-minute overtime period is played. Subsequent overtime periods are played as necessary until one team wins at the conclusion of the overtime period. Otherwise, the team with the most points after four quarters of play is declared the victor.
24. One player from the team that gains control of the ball from out of bounds has to stand out of bounds and has five seconds to throw the ball into the court. The opposing team may defend and try to gain control of the ball. If the five-second clock expires, the other team gains control and repeats this process.

Personal Fouls

25. Players from the opposite team can try to steal the ball from the player in control. A player shall not contact an opponent or opponent's wheelchair with his hand. The wheelchair is considered part of the player. This is called a personal foul. If a personal foul occurs while the player in control of the ball is shooting, he is awarded two free throws from the free thrown line. After the second free throw, the ball is unclaimed if it is not thrown into the hoop and any player can gain control of it. Otherwise, the other team gains control of the ball out of bounds. See Rule 26 for out of bounds play.
26. A foul does not have to involve the player with possession of the ball. It can involve another player if he is "rough-housing" other players to try to obtain to the ball when it is uncontrolled or to establish an offensive position. If the foul is caused by a defensive player, the team currently with control of the ball keeps it. If the defensive team is in foul penalty, free throws will be awarded to the offensive team (see below). If the foul is caused by an offensive player, control of the ball goes to the other team. The controlling team gets the ball from out of bounds. See Rule 26 for out of bounds play. *This type of personal foul can easily be ignored in this game. Unless there are ten gamers playing at a time, some of*

the players on the court are going to be computer-controlled. In this case, they can be programmed to play fairly and not foul any other players not controlling the ball.

27. If the foul occurred while not in the process of shooting, the controlling team gets the ball from out of bounds. See Rule 26 for out of bounds play. Each player is allowed five fouls in a game. After the fifth foul, he is ejected from the game.
28. A team is allowed four personal fouls per quarter. On the fifth and subsequent fouls in a quarter, the player that was fouled is allowed two free throws as a penalty. After the second free throw, the ball is unclaimed if it is not thrown into the hoop and any player can gain control of it. Otherwise, the other team gains control of the ball out of bounds. See Rule 26 for out of bounds play.

II STRATEGIES

The information on team strategies in wheelchair basketball has been limited. However, we have learned that Wheelchair basketball is played in much the same way as regular basketball. There is of course a tip-off, in which is won by the team with the greatest reach. At times, some players will tip their chairs up on one wheel in order to gain an advantage over the other team. In wheelchair basketball, the wheelchair is considered as part of the player. If the player falls out of his or her wheelchair, the play keeps on unless a player is in harms way, in which case the play is stopped. Some players have been known to crawl into harms way to prevent a play from being played out.

While the information on team strategies in wheelchair basketball has been limited, contacts have been made in order to learn more. Mike Frogley of the University of Illinois, Champaign-Urbana, who coaches wheelchair basketball, is very willing to support the wheelchair basketball IPRO. The support of the Rehabilitation Institute of Chicago (RIC) has also been gained. With these two contacts and their support, the wheelchair basketball IPRO is surely going to be successful.

III PLAYERS

Avoidatrak is going to have a group of players associated with it that are not limited in regard to gender, age, race, etc. The only area in which the players have to be classed is according to their disabilities. The National Wheelchair Basketball Association (NWBA) has declared three classes of disabilities under which all players are classified. These classifications will also be used in Avoidatrak to be consistent with the rules that the NWBA established for the game itself. The purpose of these classes and the rules that follow are:

- To encourage more individuals with severe disabilities to participate.
- To extend the opportunities of participation to more individuals.
- To encourage new teams.
- To make competition more equitable among existing and new teams.
- To counter a tendency on the part of some teams to use exclusively players with lesser disabilities, thereby discouraging people with severe disabilities and making for inequitable competition.
- To maintain high standards of competition, quality of play and spectator interest.

The following ins a brief description of the categories of paraplegia as referenced to in the NWBA rules (<http://www.sexycord.com/Paraplegia.html>):

- T1: Some decreased finger and hand function, weakness of trunk control, independent in most physical and self-care activities in wheelchair, Some light housekeeping may be performed.
- T4-T6: All muscles of the upper extremities are functioning, partial trunk paralysis, no abdominal muscles are innervated, can do some heavy lifting from a sitting position, independent in light housekeeping.
- T7-L2: Abdominal muscles are partially innervated, better trunk stability, can ambulate with difficulty using braces and crutches.
- L3-L4: has trunk control and stability, has some paralysis in legs, can ambulate with short leg braces and crutches or a cane, may use wheelchair for long distances and sports.
- L5-S3: Partial to full control of legs, able to walk if foot flexion is strong enough.)

The following is a description of each class of disability according to the NWBA Class I: Complete motor loss at T7 or above or comparable disability where there is total loss of muscle function originating at or above T7.

- Class II: Complete motor loss originating at T8 and descending through and including L2 where there may be motor power of hips and thighs. Also included in this class are amputees with bilateral hip disarticulation.
- Class III: All other physical disabilities as related to lower extremity paralysis or paresis originating at or below L3. All lower extremity amputees are included in this class except those with bilateral hip disarticulation. (See Class II) Section

Each classification will be given a numerical value or factor as follows:

- Class I = 1 value point
- Class II = 2 value points
- Class III = 3 value points

At no time in a game shall a team have players participating with a total of value points greater than twelve, nor more than three Class III players playing together at the same time.

Each player on the team must be designated as Class I, II, or III. The classification must also be placed as a Roman numeral (I, II, III) prominently and in a common line between the player's name and jersey number designating that player's disability classification. (www.nwba.org)

It will be up to the designers/programmers to implement a check to ensure that no team violates this rule. Not only must this be done at the beginning of each quarter, but also at times of substitutions to make sure that the substitution will have a team violating the rule.

IV SKILLS

The following is a summary of the fundamental skills of wheelchair basketball obtained from the references below. Practice sessions should be designed for all players to practice all of these skills both individually and with teammates. The following references were used in determining the skills required for players to play and excel in wheelchair basketball:

<http://www.sheffield-steelers.co.uk/Pages/rules.htm#Pushing>

http://64.233.167.104/search?q=cache:qd9O1C7QngJ:www.sasc.org.za/ClientFiles/WHEELCHAIR_BASKETBALL.pdf+wheelchair+basketball+mobility+and+shooting&hl=en

Individual skills without the ball:

- Starting & stopping the wheelchair requires great upper body strength
- Pivoting, especially the knowledge gained through practice on the wheelchair
- Wheeling on straight and curved paths

Individual skills with the ball

- Shooting (set shot and lay-up) is usually more accurate when the chair is stopped or speed is reduced. However, with practice, shooting while moving may become easier for the player depending on his skills.
- Passing & catching (chest pass, bounce pass, baseball pass). Bounce-passing: the idea is to pass the ball underneath the defender's outstretch arms. Since the ball will slow after bouncing, aim to hit the floor about two-thirds of the way to the receiver.

- Dribbling (combined with putting the ball on the lap and pushing the wheelchair). Dribbling with the hand farthest from the opponent will help keep possession of the ball. It is best to keep one's head up and not look at the ball. The hand, wrist, and arm control the height and speed of the bounce. It is best for the use fingertips when dribbling and not let the hit the palm of the hand.
- Picking up a loose ball from the floor
- Rebounding (offensive & defensive)

Basic offensive skills

- Getting into a clear position to receive a pass
- Setting and using picks and screens
- Give-and-go (a player passes to another player and rushed toward the hoop hoping to get the ball passed back for an easy shot or lay up)
- Utilize an offensive formation

Basic defensive skills

- Defending against the dribbler
- Defending against the set shot and lay-up
- Defending against picks and screens
- Players can attempt to steal the ball off an opponents lap as long as there is not contact made with the player or the player's wheelchair

V MODES OF PLAY

In Avoidatrak, there will be four modes of play that increase in difficulty of control and player skills and requirements. There are also other considerations that can be added at the designers'/programmers' discretion.

1. Training/Practice mode

- An optional "Coaching" mode which corrects mistakes and offers tips
- Ability to select the three different control modes
- Able to play with or without opponents so players can learn both control and strategies.

2. Mode 1: ("minor")

- Full mobility of all characters with respect to wheelchair physics
- Simple mobility controls: forward, reverse, turn
- An automated steal mode
- No team commands

3. Mode 2: ("Major")

- The following are in addition to the above options. Utilizing the advanced controls would make defeating the computer easier.
- A point system in which players with more mobility cost more than others

- Controls become more complicated
 - Two pressure sensitive buttons (e.g. a Sony controller) control speed for forward and reverse in addition to a brake button. This would allow for more maneuvers.
 - A more restrictive fouling system in which any contact between chairs is now a penalty.
 - Stealing now requires maneuvering and button pressing.
4. Mode 3: ("Pro")
- The following are in addition to the above options. Utilizing the advanced controls would make defeating the computer easier.
 - A more advanced control system. Each wheel has a separate forward and reverse.
 - A team-management system in which commands and formations can be issued

Considerations:

- A coaching system that would allow a player to either receive, advise or turn over control of teammates to a progressively smarter coach
- A buying/trading system to obtain better players and coaches
- An experience system that increases your characters abilities (shooting, passing, speed, maneuverability)

VI SOUNDS

The following is a description/list of the sounds that will need to be incorporated into Avoidatrak. The sounds can be obtained in numerous ways: actually recording them at an actual basketball game, locating wav files online, computer created.

- Referee Whistles to stop play
- Ticking timer when time is running low on shot clock, play clock, out of bounds, etc.
- Ball dribbling/bouncing on court
- Ball hitting wheelchair on fly
- Ball hitting wheelchair as a roll/small bounce
- Ball hitting rim but missing (most likely need multiple sounds)
- Ball hitting backboard
- Ball through hoop hitting rim
- Ball through hoop without hitting rim at all
- Hands catching ball
- Hands tipping ball
- Hands hitting hands (foul)
- Wheelchair wheels screeching (sudden stop??)
- Wheelchairs hitting each other (bump)

- Wheelchairs hitting each other (crash)
- Wheelchairs overturning (if incorporated into the game)
- Horn (time runs out)
- Background music and/or crowd general noise (talking)

These sounds also have to do with the Organization/meaning group but are important:

- Crowd cheering
- Crowd booing
- Coach yelling
- Coach loud talking (shouting plays if incorporated)
- Players shouting to each other (for ball)
- Players yelling (upset or showing emotion)
- Players cheering
- Players hurt (fouls, overturn wheelchair)
- Putting energy into shot (umphh)
- Players tiring but still exerting energy

VII INTERFACE

There are three distinct types of controls that lend themselves to this project to fulfill the goals of an educational, fun, and challenging game.

1. NOVICE

- Novice control methods begin with simple stick motions on an analog joystick. Either a self joystick, or more appropriate for the project, a small analog stick that is commonly found on console games as an additional finite control.
- This basic control works as one would expect. Pushing the stick forward will move the chair forward, back will move the change backward or slow down, and right and left move right and left.
- The stick corresponds to the stick found on wheelchairs for those that have limited arm motion. It allows the mobility of the chair for those unable to directly manipulate their motion via the wheels.
- The advantage for gameplay is simplicity. It allows for a new user to quickly begin playing and comprehending the activities on the court.

2. ADVANCED

- Advanced controls utilize pressure sensitive buttons found on a few newer console controllers. Given 4 buttons, two per side, stacked one above the other, the player may press any button and effect motion.
- Motion in a wheelchair requires the application of force to each wheel, either in turn, or simultaneously. As the buttons are pressed, the wheelchair changes speed and direction.
- The left hand's forefinger and middle finger hold the left buttons. The right hand's forefinger and middle finger hold the right buttons.
- Pressing the forefinger button down results in a forward motion of the wheel on a particular side.
- Pressing both forefingers in unison and with equal intensity will result in a straight forward motion.
- Pressing both middle fingers in unison will result in a reverse motion or slowing down of the chair.
- Pressing alternate fingers on both sides will result in spinning of the chair.
- In this mode, motion is carried out by how hard one directs the wheels of the chair. This mode demonstrates the complexity of moving a wheelchair (two independent wheels) in a simplistic manner. It allows one to realize the mechanics of motion without requiring one to jump directly into dual, rotational, wheel-directed control.

3. EXPERT

- Expert controls are direct control over the rotations of the wheels. Two analog sticks provide devices which can simulate the applied arm motions used to drive a chair. (See picture below)



- There are two possible techniques. They are subtle and overlap, but the difference may be a changed understanding of how the wheelchair operates.
- Rotation of the sticks is mirrored across the center of the controller. This matches the orientation of a wheelchair. To produce forward motion, the wheels must spin in opposite directions. Rotations may be performed using a single wheel or both wheels, resulting in wide or in-place turning.
- Rotation of the left stick counter-clockwise will result in the left wheel moving in the forward direction. Rotation in the opposite direction will result in backwards motion.
- Rotation of the right stick clockwise will result in the right wheel moving forward. Rotation in the opposite direction will result in backwards motion.
- Manipulation of the analog stick may be handled in multiple ways. Using full rotations provides the most simple implementation.
- Tracking the force based upon complete rotations or speed of a complete rotation may prove easier to develop, but may not be representative of the motions the driver of the wheelchair must actually perform.
- Using half-circle or crescent shapes to define the force applied would simulate the drawing back of the hands when applying force to the wheels, but may not be as intuitive for those new to wheelchairs. The force could be derived from time from point to point on the half-circle/crescent.

- The following pictures demonstrate the control of the wheelchair depending on the use of the keypad:



motion)

(forward



spin)

(left



d motion)

(backwar



spin)

(right

As can be seen, there is a lot that has to be put into the creation of Avoidatrak. However, if these ideas are implemented, not only will this game be very realistic, it will also be very entertaining to all who play it. This is how to make Avoidatrak a success.