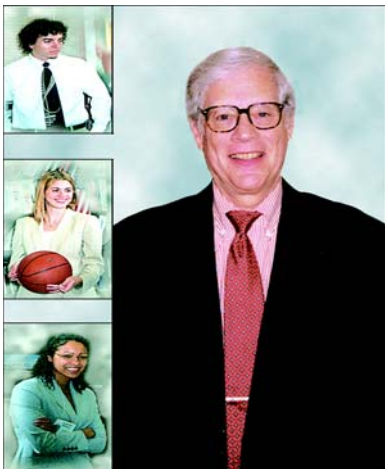

Andrew F. Conn
Sidebar, top to bottom: **Steve Garber, Alissa Burkholder, and Ashanna Randall**

Basketball for the blind—A key step in developing navigational skills

Hand-eye coordination gradually develops with considerable practice in young sighted children, which enables them to eventually catch a ball, hit a baseball with a bat, or perhaps become a professional tennis player. Hand-ear coordination in blind children (or adults) is an essential step in learning to navigate while guided by their ears in a room crowded with furniture or on a busy city sidewalk.

Prior to the novel project I am about to describe, various rather crude basketballs were available for use by blind persons. These balls contained passive noisemakers, such as embedded bells, but once these balls rolled to a stop, they became "invisible" to a blind person. This led Mike Bullis, Business Services Development Manager for Blind Industries and Services of Maryland (BISM, Baltimore, Maryland), to contact Johns Hopkins University (Baltimore, Maryland) in the hopes of finding a way for blind persons to play basketball. Not only would this have obvious fun and exercise benefits, but this ability to play basketball would also significantly boost development of that essential skill of hand-ear coordination.

In our first meeting to discuss the possibilities of such a project, Mr. Bullis demonstrated for me how his very developed sense of sound enabled him to know how sounds were reflected—whether they were adjacent to a car, a concrete pillar, or another person in an underground parking garage.

I am the instructor for the Hopkins mechanical engineering class known as Senior Design (short for Engineering Design Project). Under Bullis' tutelage, I learned the importance of developing the means for blind persons to play basketball and thus Project A-BALL—standing for Audible Basketball for ALL—was born as a student design project for my Senior Design class. The project's team members were Alissa Burkholder, 22, an engineering mechanics major from Allentown, Pennsylvania; Steve Garber, 21, a mechanical engineering major from Lugoff, South Carolina; and Ashanna Randall, 22, a mechanical engineering major from Media, Pennsylvania. (Both Miss Burkholder and Miss Randall played on the women's varsity basketball team for Johns Hopkins University, and Randall scored over 1,000 points during her Hopkins career.)

In the Senior Design class, teams of typically three or four students tackle a project assigned to them by an outside sponsoring client. This client defines what he or she needs, and the student team works to meet this need during their senior year. Project A-BALL was one of nine projects developed during the 2004–2005 school year. After projects have been presented to the entire class by client representatives, teams have been formed, and the projects' objectives and requirements have been clearly delineated, the entire class participates in a brainstorming exercise to generate numerous detailed design concepts. The elimination process then begins, which leads to the selection of

the necessary design facets for each project. At this point, the serious detailed designing by individual teams begins. After the teams create a set of drawings, they order parts to be machined or purchased and assemble and troubleshoot the device or system they have created. At the end of the year, the team's device or system, plus a detailed engineering report, is delivered to its sponsoring client.

The objective for Project A-BALL stated, "The purpose of this project is to develop equipment that will empower blind persons to play basketball. The crux of this task will involve making a basketball that emanates sound in a fashion that allows blind persons to hear where the ball is located." The detailed requirements went on to say that the ball created must simulate the characteristics of a regulation basketball—that is, have the same inertial, balance, and rebounding properties. Other requirements were that the balls be rugged and maintainable and emit a sound that would not become obnoxious over time. Also required was a means for players to locate the basket.

The brainstorming for Project A-BALL gave this team numerous ideas to explore in the following categories (or design elements): how to cause various sounds/signals, powering issues, how to construct the ball to support sound/signal sources, where to place sound/signal sources at basket, how to perceive sound/signal sources, assembly/disassembly issues, sound/signal parameter issues, reliability and maintenance, materials, and boundary systems. The last category recognized the need for players to know when they were nearing a hazard, such as grandstand seating. The nomenclature of "sound/signal" was introduced so that the means of locating the ball would not be limited to only an audible sound; thus, ideas including AM/FM radio signals, vibrations, and even smell were considered.

But the heart of this project finding a sound that would satisfy the several project requirements yet not degrade the qualities of the ball. This student team made two fortunate discoveries that led to the final project design. First was their discovery of the "Infusion Pump" basketball manufactured by Spalding (Springfield, Massachusetts). Second was their discovery of small piezoelectric sound makers, which could be powered by very small batteries.

The Spalding Infusion Pump basketball was affixed with an airtight plastic sleeve or cavity that protruded into the ball. In this sleeve was placed a hand-powered pump for adding a small amount of air pressure to the ball if needed during a game. Spalding was very cooperative with Team A-BALL, supplying several balls without the small pump inside. In this cavity the students positioned the system components—namely, the piezoelectric sound maker, necessary batteries, and the means to turn the sound on and off. This on-off function was accomplished with a specially designed cap that could be fully removed to change batteries or given a half turn to make or break the electrical connection between the batteries and the sound maker. This entire assembly caused no noticeable degradation in the ball's performance or handling characteristics, according to the two experienced ball players on Team A-BALL.

However, the smallest piezoelectric sound maker that the team could fit into the existing cavity in the Spalding basketball had a frequency of 1,200 Hz. In testing, the team found that this frequency was sufficiently different from that of the basket-locating sound source (to be described later) but was too high for players to easily locate the ball's position in a gymnasium. This high frequency was the result of the numerous reflections ("echoes") from the hard surfaces in the gym. In the final version of this system, a lower frequency sound source must be used.

The basket-locating sound maker was installed in a small box that was attached to the backside of the backboard with Velcro straps. This sound source was another piezoelectric sound maker, but because it had a frequency of only 800 Hz, players could easily discern this sound from the sound emitted from the basketball. In trials conducted before a large group on the last day of the school year, Mr. Bullis sank two of three foul shots, guided only by this tone from the backboard!

At the present time, BISM continues to develop and perfect this system, focusing on emitting a lower frequency sound from the basketball. BISM has obtained enthusiastic support from the Spalding Company, which is considering providing a larger

diameter cavity in the ball to accommodate a lower frequency sound source. Thus, BISM hopes in the near future to finalize development of the means for all people to play basketball, whether blind or not.

Andrew F. Conn

Department of Mechanical Engineering, Johns Hopkins University, Baltimore, MD. Email: afconn@jhu.edu.

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