Electronic Bag Toss

Final Presentation
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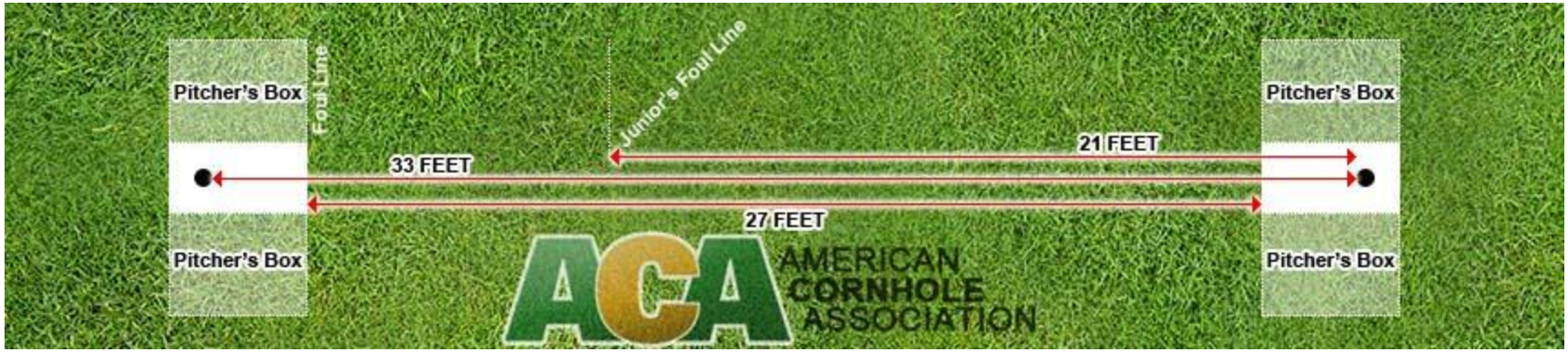
Group 11
Travis DeMint & Kabir Singh
TA: Ryan May

ECE 445 Senior Design
University of Illinois

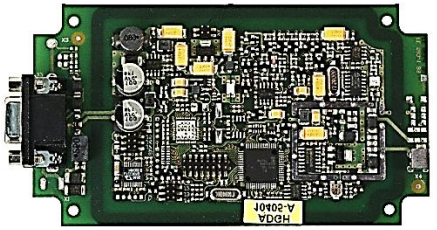
Game Explanation

- Two teams consisting of two players each
- Four bags per team
- Two playing boards spaced 27 feet apart
- Teams alternate tossing bags
- Each bag sitting on top of the board at the end of a round counts for 1 point
- Each bag though the hole during a round counts for 3 points
- First team to 21 wins



Project Introduction

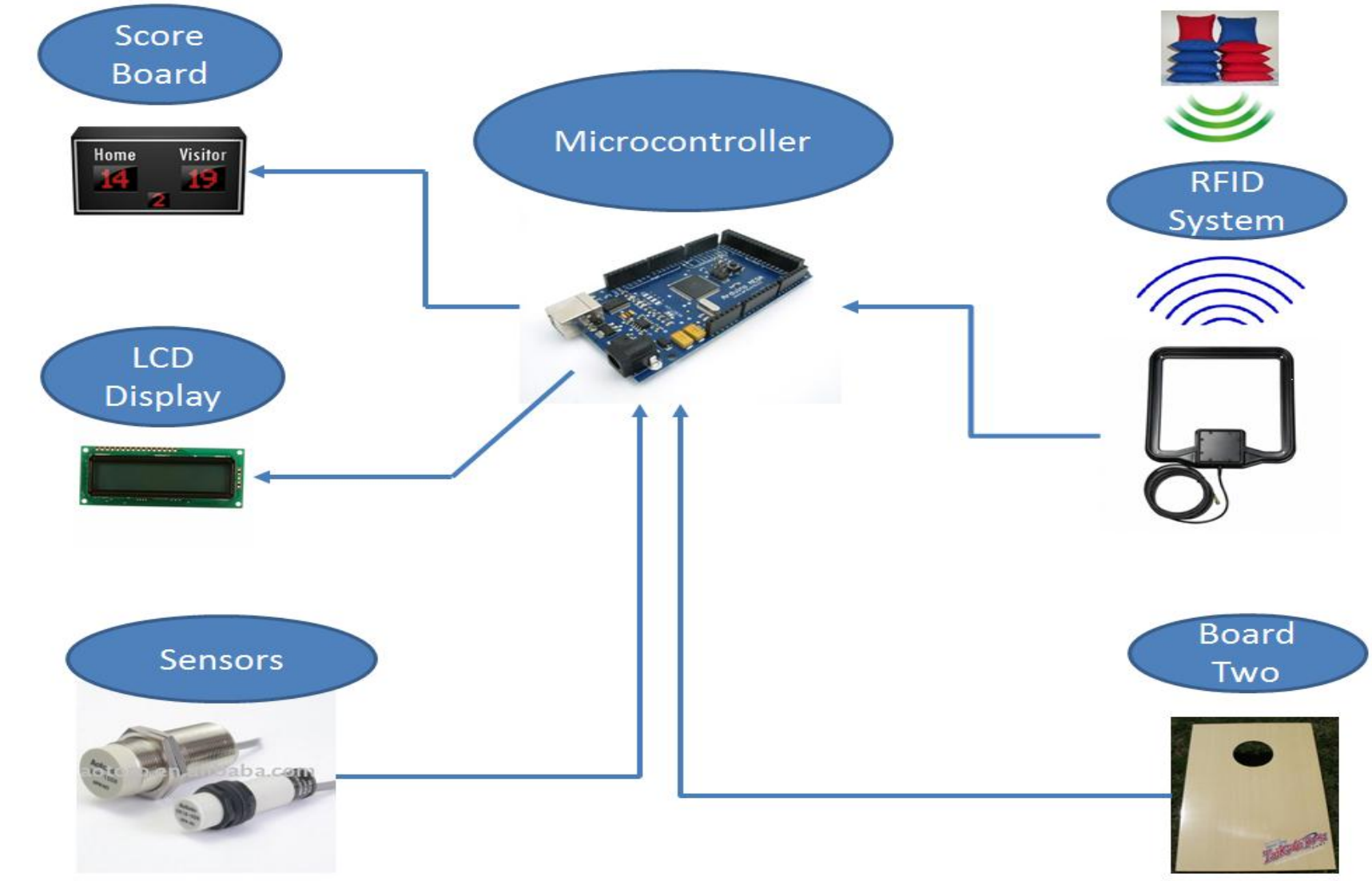
- Game Scoring
  - RFID System
    - Tag
    - Antenna
    - Reader
  - Capacitive Sensing
  - Inductive Sensing
  - Bag Filler Material
- Score Display
  - 7-Segment Displays
  - LEDs
  - LCD



Objective

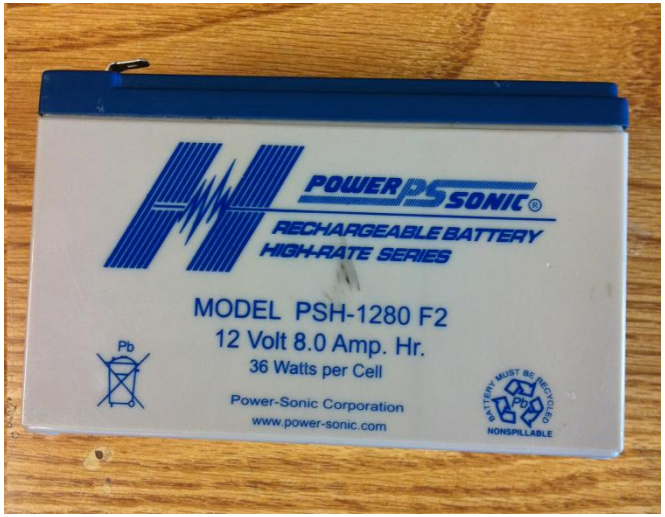
- Complete Electronic Scoring System
- Compact, standalone system
- Consistent proper functionality
- Aesthetically pleasing score display
- Easy to use human interface

System Overview



Power Supply

- PSH-1280 F2 Battery
- 12VDC
- Battery Capacity 8 Amp Hr.



$$Battery\ Life = \frac{Capacity}{Current\ Draw} = \frac{8000\ mA\ Hrs}{720\ mA} \approx 11\ \text{Hrs}$$

Sensor System (Inductive)

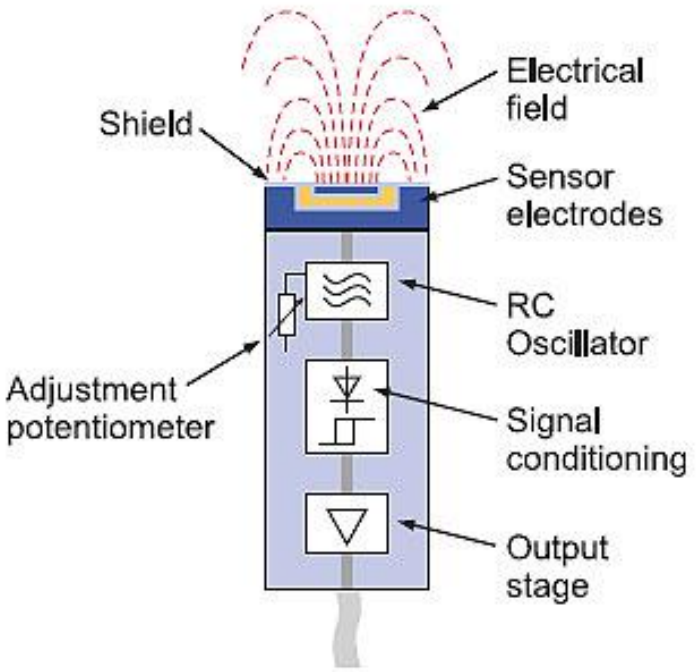
- Cutler-Hammer
- 30mm Shielded
- 12VDC Powered
- Sensing Range 10mm
- 5VDC Output
- Active Low

Sensor System (Capacitive)

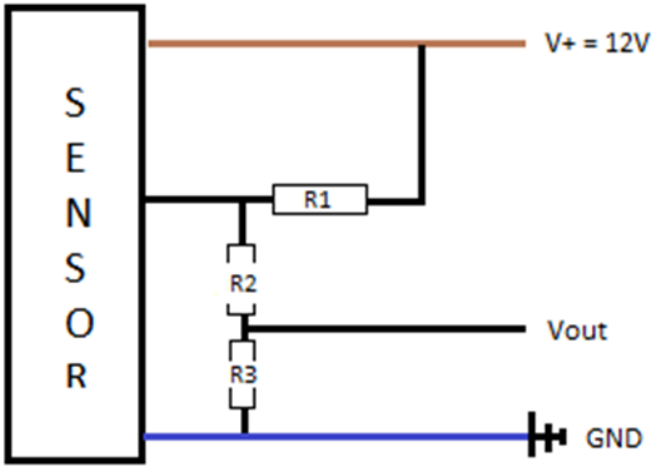
- Cutler-Hammer
- 30mm Unshielded
- 12VDC Powered
- Variable Sensing Range
- Range Set to 10mm
- 5VDC Output
- Active Low

Sensor System (How They Work)

- Emit Electromagnetic field and sense changes in field
- Inductive
  - Magnetic Field
  - Conductive objects
- Capacitive
  - Electric Field
  - Conductive and Dielectric objects



Sensor System (Circuit)



	Inductive	Capacitive
R1	14.25 kΩ	14.25 kΩ
R2	8 kΩ	14.25 kΩ
R3	14.25 kΩ	14.25 kΩ
Vout No Detection	4.7 V	4.8 V
Vout Detection	0.3 V	0.4 V

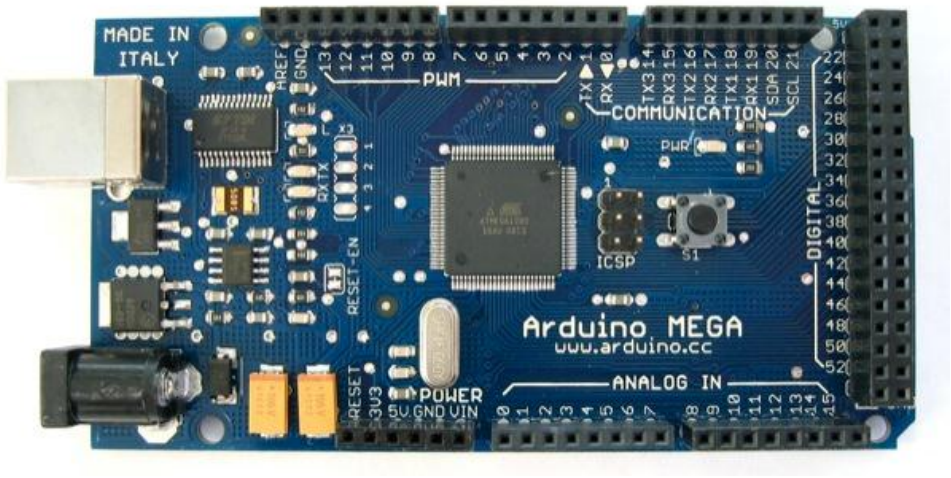
Sensor System (Functionality)

- Red bags filled with sand and steel bb's
  - Triggers both Sensors
- Blue bags filled only with sand
  - Triggers only capacitive sensor

	No Bags	Red Bag	Blue Bag
Inductive Output	High	Low	High
Capacitive Output	High	Low	Low
Microcontroller Action	None	Add 3pts to Red	Add 3pts to Blue

Microcontroller (Arduino Mega)

- Input Voltage: 7-12V
- 54 Digital I/O Pins
- 16 Analog Input Pins
- Calculates scores based on inputs from sensors and RFID system
- Drives Displays

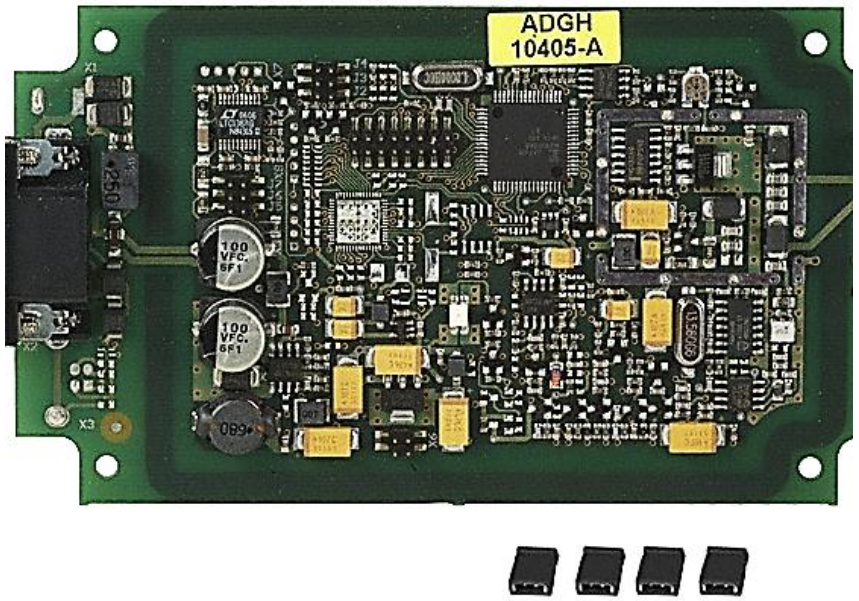


RFID System (Antenna)

- Used to transmit and receive signals
- Tuned at 13.56 MHz
- Reading distance is up to 50cm
- Transmitting power of 4 W
- Dimensions: 300x300 x 38 mm.

RFID System (Reader)

- High frequency multi-tag reader for identification of ISO transponders
- 2 operation modes: Scan-Mode/Polling-Mode
- Power supply: 12-24 V DC



RFID System (Reader)

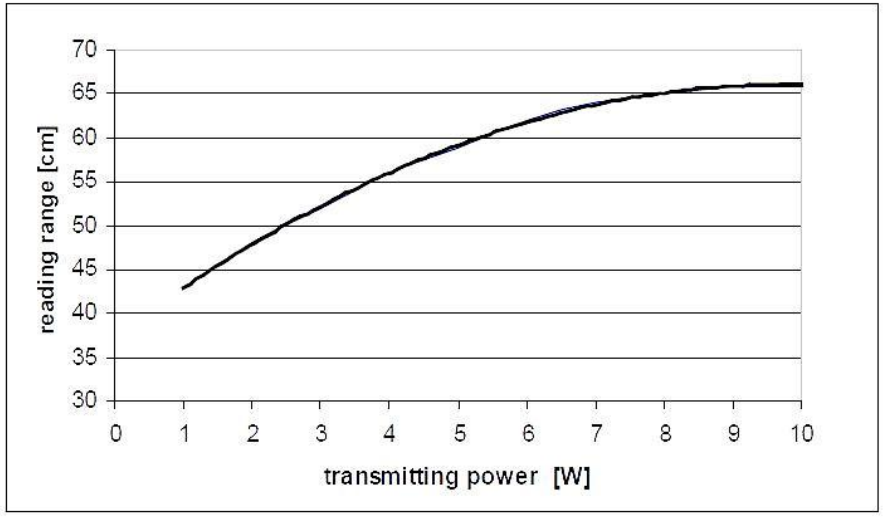
- 13.56 MHz operating frequency
- Anti-Collision Detection
- 1 W transmitting power with external antenna
- RS232 interface

RFID System (Reader Software)

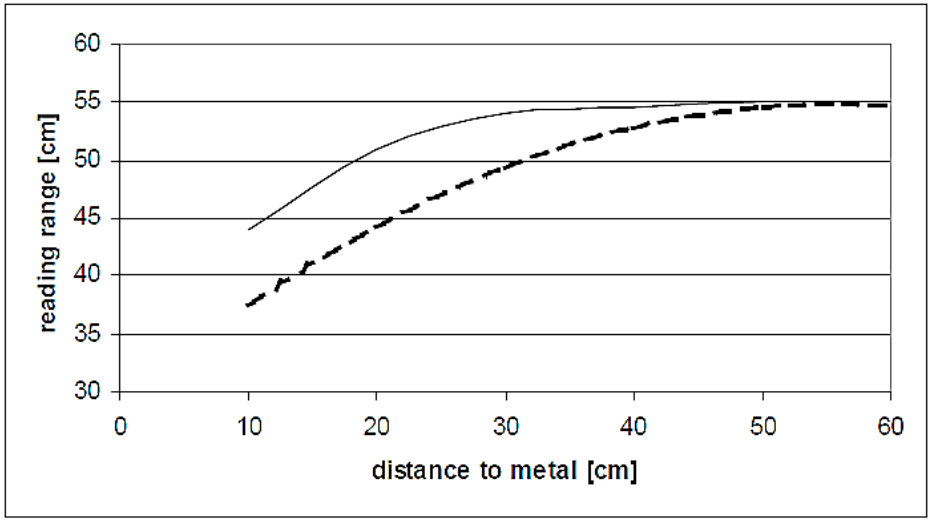
- ISO-Start
  - Reader Calibration Software
  - Tag Selection
  - Reader Mode Selection
  - Tag Identification

RFID System (Range)

- Antenna Range with 45mm x 76mm transponders vs. transmitting power

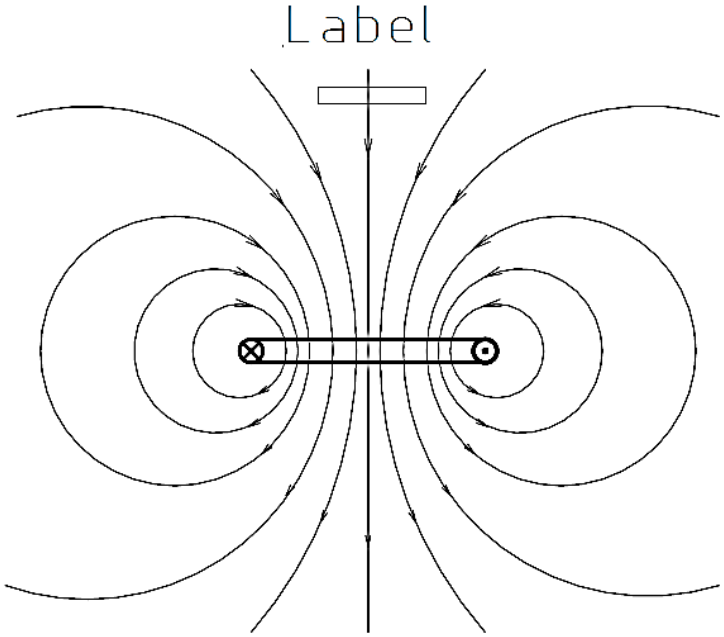


- Antenna Range with 45mm x 76mm transponders near metal



RFID System (Range)

- Influencing Factors
  - 1 W transmitting power
  - Perpendicular Tag Placement
  - Tag interference
  - Cable placement
  - Metal in red bags
- Measured Range
  - 16.5 inches from center of antenna in all directions
- Board Dimensions
  - 36in x 24in
- Antenna Coverage
  - 33in x 33in



RFID System (Serial Comm.)

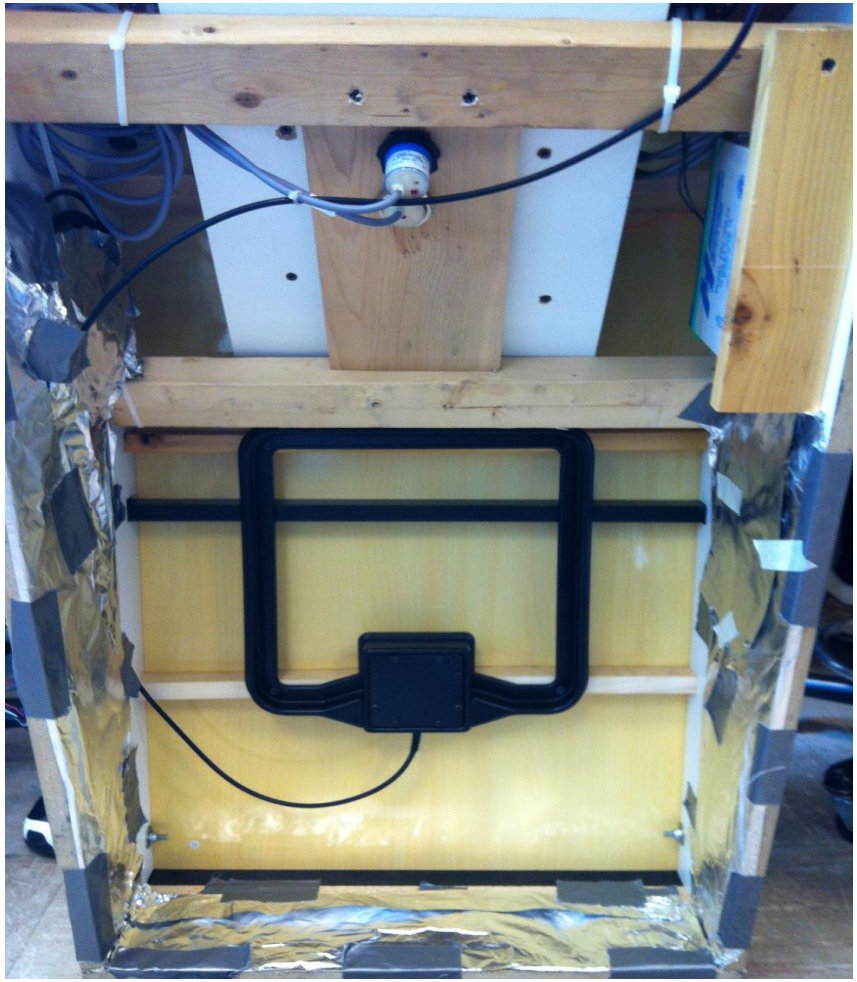
- Arduino shield converts serial RS232 data from RFID reader using max232 chip
- Uses RX and TX on Arduino board to send in converted TTL serial data

RFID System (Tags)

- TI Tag-it HF standard transponders
- Consists of a 45mm x 76mm loop antenna and chip microprocessor
- Receives 13.56 MHz signal from antenna and sends back a coded signal to the reader

RFID System (Shielding)

- Aluminum Foil was used to shield outer perimeter of game board
- Reduces electromagnetic field in the space occupied by the foil



Human Interface (Switches)

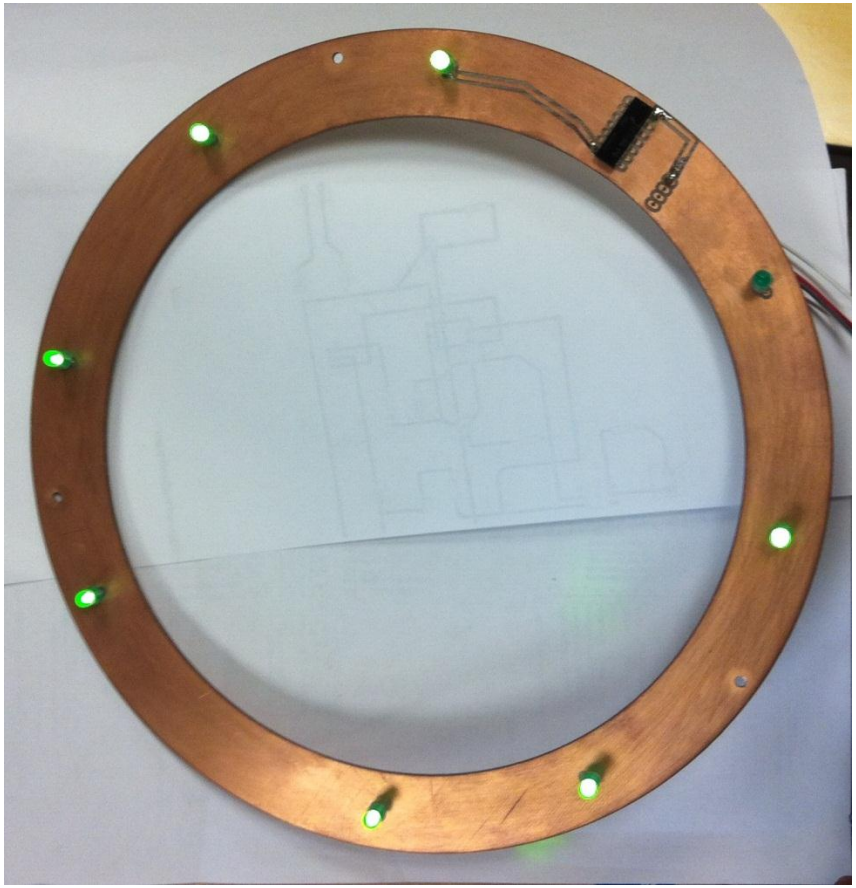
- Power Switch
- Score Reset
- End of round
  - Scores RFID system

Board 2

- Simulate game being played on second board
- Used switches to simulate 1 and 3 points for both teams

Display (LEDs)

- 8 High Intensity Green 10mA LEDs
- Driven by 8-bit Serial-In Parallel-Out Shift Register
- Light in circular pattern 3 times when either team makes a 3pt shot



Display (7-Segment)

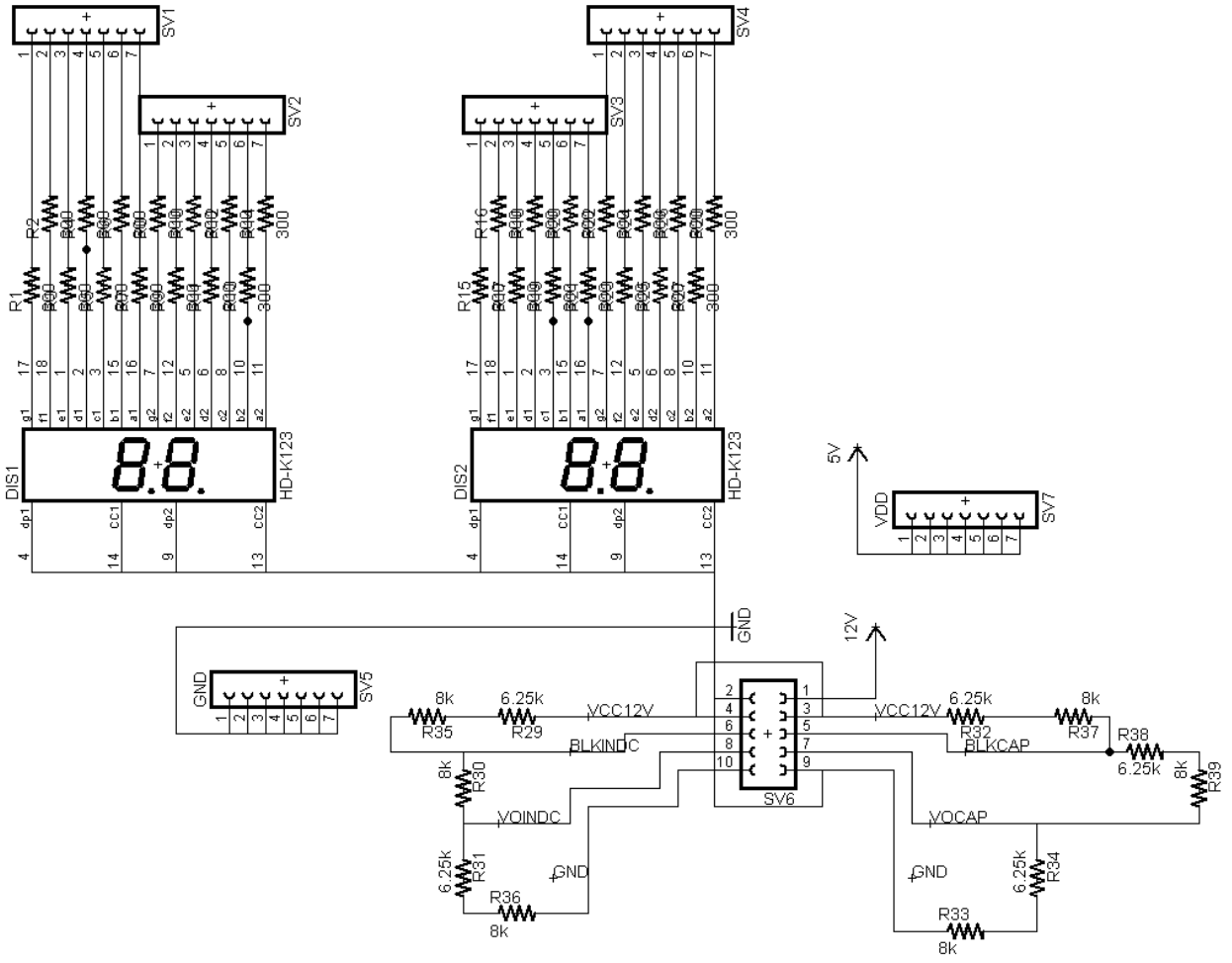
- Two, 2 digit common cathode 7-segment displays
- Used to display current score for each team
- Resistor Calculation:
  - If = 10mA
  - Vf = 2.2V
  - Vs = 5V

$$R = \frac{Vs - Vf}{If} = \frac{5 - 2.2}{.01} = 280\ \Omega$$

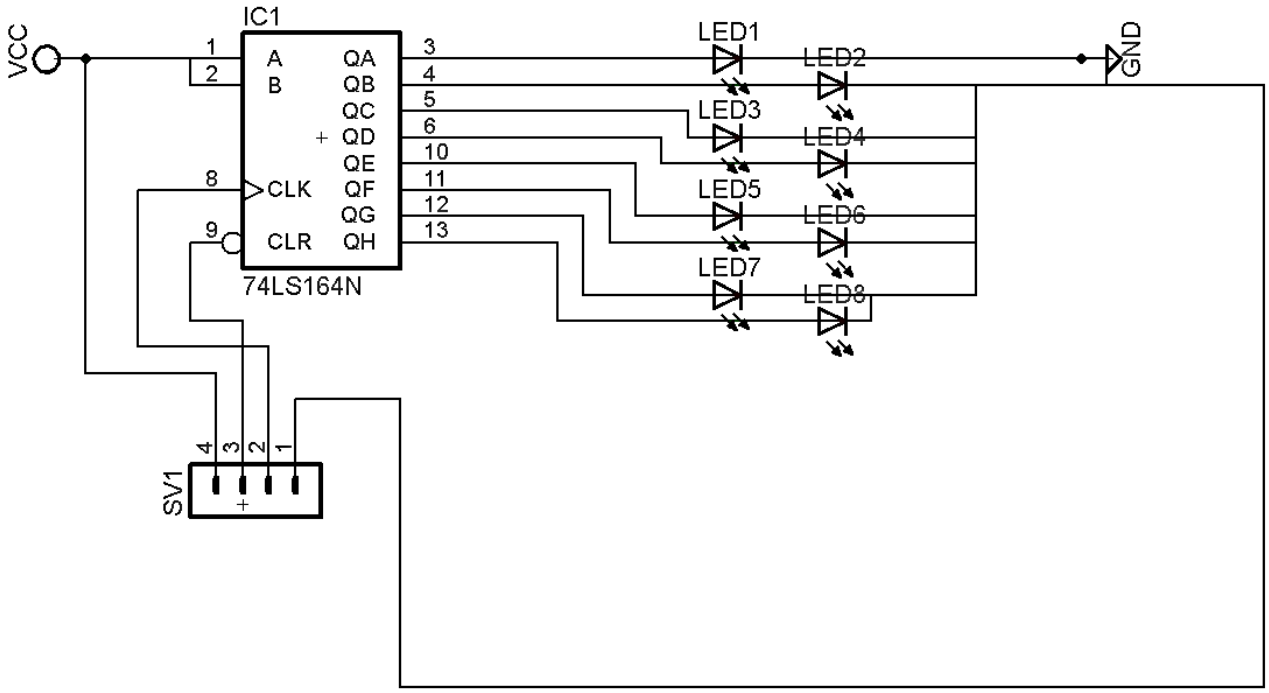
LCD Display

- LCD display module 16x2 characters
- Informs players of every point that was accumulated
- Determines the end of the game and accounts for any ties

Display Schematic



LED Schematic



Project Conclusion

- Met all verification and testing procedures
- Project exhibits proper functionality of all parts in the system
- Completely scores entire game of bags

Ethical Considerations

- Rule Three IEEE Code of Ethics – "to be honest and realistic in stating claims or estimates based on available data"
- Rule Five IEEE Code of Ethics – "to improve the understanding of technology, its appropriate application, and potential consequences"

Resources

- Professor Jennifer T. Bernhard
- Bill Coulter, Technical Support Manager, FEIG Electronics
- American Cornhole Association, http://www.playcornhole.org/rules.shtml
- Design World, http://www.designworldonline.com/articles/5427/208/The-Search-for-a-Better-Proximity-Sensor-Starts-Here.aspx