Automated Dartboard Scoring

6.111 Final Project By:
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Project Concept

• Dart scoring in local leagues is performed by hand
• Why not automate this repetitive task?
# Rules of 301

<table>
<thead>
<tr>
<th>Player 1</th>
<th></th>
<th>Player 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>301</td>
<td>301</td>
<td>254</td>
<td>38</td>
</tr>
<tr>
<td>200</td>
<td>263</td>
<td>47</td>
<td>20</td>
</tr>
<tr>
<td>54</td>
<td>243</td>
<td>52</td>
<td>0</td>
</tr>
<tr>
<td>Winner</td>
<td>52 loser</td>
<td>Winner</td>
<td>52 loser</td>
</tr>
</tbody>
</table>

The dartboard image suggests the game of Darts is being played, where players attempt to hit the inner rings for higher scores, aiming for the 301 as a target score to finish with.
Dart Detection

- Microphone Triangulation
- Use difference in time between when dart signal reaches microphone

\[
(d-\varepsilon_1)^2 = (x-x_1)^2 + (y-y_1)^2 \\
(d-\varepsilon_2)^2 = (x-x_2)^2 + (y-y_2)^2 \\
(d-\varepsilon_3)^2 = (x-x_3)^2 + (y-y_3)^2
\]

- 3 equations...3 unknowns (x, y, d)
Dart Detection Resolution

• Speed of Sound = 340.29 m/s
• Clock Speed = 1MHz
• Resolution = \( \frac{340.29 \text{ m/s}}{1,000,000 \text{ Hz}} \) = .00034 m/cycle < 1mm/cycle

• Problems With This:
  – Delay of analog circuitry
  – Peak detection
High Level Project Description

Latch Mic Inputs

Count Clock Cycles Between

Triangulation

301 Game Logic

Graphic Display

Koosh

Mike
Mike’s Block Diagram

- xvga
  - Labkit.v
  - Dart Location Blob
    - DBPicture
      - Screen Text
      - 301 scoring Module
        - SQRT Module
          - Inverse Tan Lookup
          - Dart inputs from Koosh (x,y) coords

- clk
- reset
- new turn button
Must Haves

• 301 game play without double in and double out rule
• 2 player games
• Graphical display on screen
• Dart detection within 1 inch
Nice To Haves

• Fixing incorrect dart placement
• Correction for darts that don’t stick in the board
• Other games (like 601, cricket)
• Target practice
• Dart detection within 1cm
• Detecting doubles and triples