agility trainer

WEARABLE PAIRED WITH ATTACHABLE SENSORS TO GIVE FEEDBACK ON AGILITY PERFORMANCE
Agility Trainer

Tracks position, velocity, acceleration, and timing data

Passing beacons segments the logged data

Transfers data via Bluetooth to computer

1 waist strap wearable
4+ clip-on beacons
Mockup consists of an accelerometer/gyroscopic sensor attached to the waist with an adjustable elastic band.

<table>
<thead>
<tr>
<th>Customer Need</th>
<th>Attributes</th>
<th>Engineering Specs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intuitive physical interaction with the product.</td>
<td>Wearable</td>
<td>Adjustable strap around waist</td>
</tr>
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</table>
User Needs

- Split drills into segments and measure times with high precision
- Accurate and independent measurement
- Data analysis and logging over time
Interviewed athletes from lacrosse, football, volleyball, water polo, hockey, baseball, tennis, rowing, basketball, and track.

90% perform agility drills, on average 2-3 times per week.

100% said wearables could integrate into these drills.
User Feedback

Users consistently asked for more information about their **directional changes:**

- deceleration into/acceleration out of the turn
- time feet spend on ground
- turn angle

![Diagram]

5-10-5 Drill

Box Drill
Price Point

Agility Equipment
$25

$40-$75

Fitness Wearables
$45 - $100

Which price point within the $40-$75 range?
### User Interface

#### Playback

![Playback interface](image)

#### Last Run

<table>
<thead>
<tr>
<th>Zone</th>
<th>Time</th>
<th>Average Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.38 sec</td>
<td>2.10 m/s</td>
</tr>
<tr>
<td>2</td>
<td>0.95 sec</td>
<td>0.43 m/s</td>
</tr>
<tr>
<td>3</td>
<td>1.87 sec</td>
<td>1.62 m/s</td>
</tr>
<tr>
<td>4</td>
<td>1.11 sec</td>
<td>0.36 m/s</td>
</tr>
<tr>
<td>5</td>
<td>3.42 sec</td>
<td>2.07 m/s</td>
</tr>
<tr>
<td>6</td>
<td>1.01 sec</td>
<td>0.39 m/s</td>
</tr>
<tr>
<td>7</td>
<td>1.56 sec</td>
<td>1.84 m/s</td>
</tr>
<tr>
<td>8</td>
<td>0.82 sec</td>
<td>0.55 m/s</td>
</tr>
</tbody>
</table>

**Total**

<table>
<thead>
<tr>
<th>Time</th>
<th>Average Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.12 sec</td>
<td>1.17 m/s</td>
</tr>
</tbody>
</table>

#### Personal Best

**0.78 sec**

#### Last Run

**0.95 sec**
appendix
Appendix A: Collapsible Speed Bump


• 2013, Steel Plates Requirements Used in Connection with Roadway Utility Excavations, Charleston.
Appendix B: Governor Calculations

Worst Case Power Dissipation (~700 W) and Wheel Torque (1.2 Nm)

- Assuming wheel radius = 0.35 mm, 10% grade hill, rider mass = 80 kg, Time of cruise = 150 s, cruise speed = 20 mph, and one power dissipator:

Change in Y:

\[ \Delta Y = -v_{\text{cruise}} t_{\text{cruise}} \sin(\Theta_{\text{hill}}) \]

Change in PE:

\[ \Delta PE = mg (h_i - h_f) = mg \Delta Y \]

Required Dissipation:

\[ P_{\text{system}} = \frac{\Delta PE}{t_{\text{cruise}}} \]

Wheel Torque Required:

\[ \tau_{\text{wheel}} = \frac{P_{\text{system}}}{\omega_{\text{wheel}}} \]
## Appendix C: Product Contract

<table>
<thead>
<tr>
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<th>Attributes</th>
<th>Engineering Specs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrates into existing agility drills.</td>
<td>Ease of Installation</td>
<td>Clips on to cones or ladder</td>
</tr>
<tr>
<td>Intuitive physical interaction with the product.</td>
<td>Wearable</td>
<td>Adjustable strap around waist</td>
</tr>
<tr>
<td>Sensor housing does not wear out or break after repeated use.</td>
<td>Durability</td>
<td>Rockwell R Hardness: 103-112</td>
</tr>
<tr>
<td>Provides actionable feedback to user.</td>
<td>Sampling</td>
<td>Resolution of +/- 16g, Range of 5-6 feet</td>
</tr>
<tr>
<td>Does not interfere with performing the agility drill.</td>
<td>Product Cost</td>
<td>Weight of &lt;0.5 lbs, Volume ~50 cm$^3$</td>
</tr>
</tbody>
</table>