Hurricane Activated Window Closers

Concept
Detects hurricane conditions, then sends out a signal to automatically close shutters
What is a hurricane shutter?

Prevents debris from breaking windows leading to high pressure build-up, which can tear off the roof.

Products on the market: motorized shutters, manually installed panels.
Need for Automatic Detection

- High risk areas’ building code often requires hurricane shutters
- Issues with preparing a house for a hurricane
  - Can take up to a day
  - Labor intensive
  - Dangerous: cause of 100 deaths in Hurricane Rita
Product Differentiation

Completely autonomous

- Real-time weather sensing
  - 70 mph wind speed
- Minimizes user effort
- Emphasis on safety
Critical Module: Sensing - Motor

- Sensing: Digital wind speed sensor
- Microcontroller: Arduino
- Motor Control: H-Bridge
- Motor & Gearing: 150 W motor
- Protection System: Hurricane Shutters

Backup Power
- UPS and Voltage Regulator

Safety
- Photo-interrupter
Target customers:
vacation home owners, multi-story dwellings, elderly

<table>
<thead>
<tr>
<th>Component of Product</th>
<th>Estimated Sale Price</th>
<th>Basis for Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Controller</td>
<td>$200 - $300</td>
<td>Home weather sensors, monitoring systems</td>
</tr>
<tr>
<td>Add-ons per Window</td>
<td>$100</td>
<td>Motor + sensors</td>
</tr>
</tbody>
</table>

Motorized steel shutters = $30 per sq. ft + installation costs => upwards of $50,000 per home
Product description: Device detects hurricane conditions & automatically triggers shutters.

Intended customers: Homeowners in hurricane prone regions.

Market: Hurricane protection products.

<table>
<thead>
<tr>
<th>Customer Need</th>
<th>Product attribute</th>
<th>Engineering Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability</td>
<td>Product lifespan</td>
<td>&gt; 10 years</td>
</tr>
<tr>
<td>Can deploy quickly</td>
<td>Time for closing and opening shutters</td>
<td>≤ 1 minute</td>
</tr>
<tr>
<td>Operates when power in home is out</td>
<td>Cycles of operation without power</td>
<td>&gt; 2 cycles</td>
</tr>
<tr>
<td>Few false positives</td>
<td>False positives per season</td>
<td>≤ 1 per season</td>
</tr>
<tr>
<td>Low installation costs</td>
<td>Price per window</td>
<td>≤ $300</td>
</tr>
</tbody>
</table>
Major Risks

• Does it sense a hurricane?
  – What defines hurricane conditions?

• Does it react to weather data?
  – Sensor/motor interface

• Market acceptance & usability
  – Retrofitting current systems
  – Working with contractors?
# Risk Resolution

<table>
<thead>
<tr>
<th>Risks</th>
<th>Testing</th>
<th>Validation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing</td>
<td>Wind sensing</td>
<td>Tested up to 50 mph</td>
</tr>
<tr>
<td>Actuation</td>
<td>Motor response</td>
<td>Limit switches &amp; proper directions</td>
</tr>
<tr>
<td>Market</td>
<td>Interviews</td>
<td>Confirmation of need – D. Griffin (FDEM)</td>
</tr>
</tbody>
</table>

## Future investigation
- Realistic conditions
- Use network data to cross-check detection system
- False positives