Mockup Presentation

Silver A
October 16, 2008
Unlimited Range
Unlimited Range

1. Control
2. Sensing
3. Heating Module
4. User Interface
5. Cooling
Unlimited Range

1. Control
2. Sensing
3. Heating Module
Refining Customer Needs

Before:

- Customer Needs Assessment: 130 Surveys
- One-on-One Interviews with Chef, Retailer from Yale Electric
- Benchmarking against 15 high-end stovetops
## Silver A

### Product Contract

<table>
<thead>
<tr>
<th>Risk</th>
<th>Customer Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Temperature Control</td>
</tr>
<tr>
<td>#2,3</td>
<td>Variable Burner Size/Position</td>
</tr>
<tr>
<td>#4</td>
<td>Safe Operation</td>
</tr>
<tr>
<td>#4</td>
<td>Easy to Use</td>
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<tr>
<td></td>
<td>Easy to Clean</td>
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</tbody>
</table>

Manufacturing Cost = $250  
Retail Price = $1000
Risk #1: Control

Design Attributes

Control of Discrete Elements
Range of Power
Risk #2: Sensing

Design Attributes

Pot Locating Ability
Risk #3: Heating Module

Design Attributes
Resolution
Unlimited Range

5. Cooling

4. User Interface
Handouts
Unlimited Range: Risks

Primary Risks Identified
1. Sensing the position and shape of a pot or pan.
2. Controlling an array of heating elements.
3. Constructing an insulated, modular heating element.
4. Creating an understandable graphical user interface.
5. Cooling heating elements once the range is powered off.

1. Sensing Pot Size & Position
   A) Inductance Sensor: Induce eddy currents in metal pot.
      Results:
      Senses any metal resting on stovesurface.
   B) Optical Sensor: Identify pot edges from photograph.
      Results:
      Identified pots on a stove surface. Lens must be clean. Noisy data.

2. Powering a Heating Array
   A) Lightbulb Array: 4 bulbs controlled by four relays.
      Results:
      Bulbs can be powered on in any pattern.
   B) ORC Board: Relays driven off of one ORC Board.
      Results:
      Power to bulbs can be regulated using Pulse Width Modulation

3. Heating Element Module
   A) Resistance Coils: Compact heating elements.
      Results:
      Nichrome wire provides thermoelectric properties desired.
   B) Insulation: Compact high performance coil insulation.
      Results:
      Fiberfrax Ceramic Fiber Paper provides properties desired.
Inductor Circuit

\[ V_{IN} \]
\[ 20 \, V_{pp} \]
\[ 150 \, kHz \]

\[ R_s = 50 \, \Omega \]

Diode

\[ C_1 = 0.1 \, \mu F \]

Inductance

\[ R_1 = 10 \, k\Omega \]

\[ R_2 = 300 \, k\Omega \]

\[ C_2 = 0.1 \, \mu F \]

\[ V_{OUT} \]
## Product Contract

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<tr>
<td>Easy to Use</td>
<td>Number of Steps</td>
</tr>
<tr>
<td>Easy to Clean</td>
<td>Surface Material</td>
</tr>
<tr>
<td></td>
<td>Surface Quality</td>
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Cost Break-Down

Control (+ Interface) = $170
Heating Modules (+ Glass Top) = $65
Sensing = $15
Total Manufacturing Cost = $250
(Competition = $375)

Retail Price (add in 75% Markup) = $1000
(Competition = $1500)
4. User Interface

5. Cooling