Designing User Interface for Health-aware Cooking in a Smart Kitchen

Presenter :: Arthur Jen-Hao Chen
How do we design the smart kitchen?
Nutrition-aware Kitchen

Calorie-aware Kitchen

Calorie-aware Kitchen with nutritional balance information
The Goal: Encouraging Healthy Cooking

• 3 key factors of healthy cooking
  – type of food ingredients
  – amount of food ingredients
  – cooking methods

• Provide related information during the cooking process
Related Works

CounterActive

Sour Cream Berry Tarts — Crumb Crust

Get your ingredients and tools ready!

next >
Related Works  CounterIntelligence
Related Works CookingNavi

Contextual Inquiry Findings

- Cooking habits
  - Hard to change to healthy cooking
- Taste and preferences
  - Healthy cooking affects the taste
- Complex calculation on nutritional values
  - Hard to decide the type and amount of food ingredients
- Attention
  - Cooks would like to concentrate on the cooking
Design Considerations

• Transparency
  – Enable concentrating on the actual task

• Flexibility
  – Cooking follows no standard procedure
  – Provide the option of using the system or not

• Unobtrusiveness
  – Multi-tasking environment
  – Avoid distracting information

• Glanceability
  – Facilitate quick grasping of information
Proposed Solution

The user performs a cooking action

The user then gets nutrition awareness
Hardware Design
Nutrition-aware kitchen

Calorie-aware kitchen

Calorie-aware kitchen
with nutritional balance information
Nutrition-aware Kitchen

- calories: 11/1.8 kcal
- fat: 112.14 g
- protein: 40.95 g
- carbohydrate: 2.205 g
- cholesterol: 154.35 mg
- sodium: 2649.15 mg
Overview of containers and food ingredients

stove
counter
Overview of containers and food ingredients

A container
Overview of containers and food ingredients
Detailed nutritional information

- calories: 1171.8 kcal
- fat: 112.14 g
- protein: 40.95 g
- carbohydrate: 2.205 g
- cholesterol: 154.35 mg
- sodium: 2649.15 mg
User Study

• To observe how cooks would react to the provided information and how they would interact with the system

• One experienced family cook was invited to cook four main-course servings of spaghetti with the system
Findings (1/3)

- Detailed information is difficult to interpret
- Lack of recommendation
- Difficult to track total usages

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>calories</td>
<td>1171.8 kcal</td>
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<tr>
<td>fat</td>
<td>112.14 g</td>
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<tr>
<td>protein</td>
<td>40.95 g</td>
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<td>carbohydrate</td>
<td>2.205 g</td>
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<tr>
<td>cholesterol</td>
<td>154.35 mg</td>
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<tr>
<td>sodium</td>
<td>2649.15 mg</td>
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</table>
Findings (2/3)

- Redundant information
- Unclear representation of containers
Findings (3/3)

• Effective for raising awareness of nutritional properties of food ingredients
  - The participant was surprised by the high calories in bacon and reduced the amount used
Improvement

• Simplify nutritional information
• Provide recommendations
• Remove redundant information
• Represent containers clearly
Nutrition-aware kitchen

Calorie-aware kitchen

Calorie-aware kitchen with nutritional balance information
Calorie-aware Kitchen
Simplify nutritional information
Provide recommendations
Remove redundant information
Represent containers clearly
Simplify nutritional information
Provide recommendations
Remove redundant information
Represent containers clearly

recommendation on calorie

total used calorie

1488
35
506
541
Simplify nutritional information
Provide recommendations
Remove redundant information
Represent containers clearly
Container Representation

- names of food ingredients
- reminder
- calorie amount

506 Kcal
User Study

• 3 experienced cooks

• Fixed dinner menu

<table>
<thead>
<tr>
<th>Participants</th>
<th>Menu</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>Salad (with apple, celery, and thousand-island dressing); Salmon; Fried aubergine with onion; Spaghetti (with bacon, mushroom, onion, and milk)</td>
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<tr>
<td></td>
<td>New England clam chowder (from Campbell’s Condensed Soup [6]); Bream roll with bacon with special sauce (including UHT whipped cream, onion, white wine, and lemon), rice and vegetables (cauliflower, carrot, and sweet corn); Salad (with lettuce and thousand-island dressing)</td>
</tr>
<tr>
<td>P2</td>
<td>Shrimp with scrambled egg; Mapo tofu (fried tofu with meat sauce and green onion); Asparagus with abalone; Chinese Clam Soup; Rice</td>
</tr>
</tbody>
</table>
User Study Procedure

2 cooking phases
- Pretest phase without feedback
- Test phase with feedback

2 cooking sessions without feedback

3 cooking sessions with feedback

pretest

test
User Study Results

Calorie difference (kcal)

<table>
<thead>
<tr>
<th>Cooking session</th>
<th>P1</th>
<th>P2</th>
<th>P3</th>
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<td>751</td>
<td>89</td>
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<td>77</td>
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<td>1535</td>
<td>611</td>
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<td>14</td>
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<td>928</td>
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<td>840</td>
<td>0</td>
<td>-29</td>
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<tr>
<td></td>
<td>796</td>
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<tr>
<td></td>
<td>620</td>
<td>0</td>
<td>-201</td>
</tr>
</tbody>
</table>

Cooking session: 1, 2, 3, 4, 5
Findings

- Participants were interested in preparing a nutritional balanced meal
- Participants tended to disregard the system after deciding the amount of food ingredients
  - Food processing
  - Redundant information
Improvement

• Provide other information related to nutritional balance
• Focus on the planning process of selecting and measuring food ingredients
  – The decision between the counter and the refrigerator
Nutrition-aware kitchen

Calorie-aware kitchen

Calorie-aware kitchen with nutritional balance information
Calorie-aware Kitchen with nutritional balance information

• Nutritional balance information
  – Cooperated with NTU Hospital, dept. of dietetics
  – Food guide pyramid

• Help learning
  – Actual practice
Calorie-aware Kitchen with nutritional balance information

### Calorie Information
- Total used calorie: 605 + 45
- Calories per serving: 0, 0, 1, 0, 6

### Nutritional Balance Information
- Recommendation on serving
- Total calorie recommendation

### Icons and Labels
- Recommendation on calorie
- Total used calorie
- Calorie information
- Nutritional balance information
User Study

• 3 experienced cooks were recruited from a nutritional education class held at NTU Hospital

• Prepare meals for their family members
• Choose any food ingredients
User Study Procedure

3 cooking phases
- Pretest phase without feedback ×2
- Test phase with feedback ×3
- Posttest phase without feedback ×1

2 cooking sessions without feedback 3 cooking sessions with feedback 1 cooking sessions without feedback
pretest test posttest
User Study Results

![Graph showing calorie difference (kcal) across pretest, test, and posttest cooking sessions for P1 and P2&P3 participants.](image)
Findings (1/2)

- The results for P1 suggest that the provided information was sufficient to achieve the goal.
- The performance difference
  - Participants were not asked to follow the recommendations exactly.
  - The motivation of learning healthy cooking.
Findings (2/2)

- Planned before starting to prepare a meal
- Asked to turn the system off after planning
Reflection

• Evolving problem scope & DESIGN goal

Health-aware Kitchen  
↓
Nutrition-aware Kitchen 
↓
Calorie-aware Kitchen  
↓
Calorie-aware Kitchen with nutritional balance information
Reflection

- Evolving problem scope & DESIGN goal
- Limited time **USAGE** of technology
  - Ignored the system after planning
  - Asked to turn off the system after planning
Reflection

**DESIGN**
evolving problem scope & design goal

**TECHNOLOGY**
technology limitations & benefit / cost ratios

**USER**
limited time usage of technology
Reflection

• TECHNOLOGY limitations & benefit/cost ratios
  - Cost: user effort on operating the system
  - Benefit: calorie & nutritional balance feedbacks
  - High benefit/cost ratio is good
Reflection

health-aware cooking

constant b/c ratio

cooking process
Reflection

calorie-aware cooking
Reflection

calorie-aware cooking

<table>
<thead>
<tr>
<th>high b/c ratio</th>
<th>low b/c ratio</th>
<th>high b/c ratio</th>
<th>low b/c ratio</th>
<th>high b/c ratio</th>
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<td>food processing</td>
<td>planning</td>
<td>food processing</td>
<td>planning</td>
<td>heating</td>
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<td>high b/c ratio</td>
<td>low b/c ratio</td>
<td>high b/c ratio</td>
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<td>high b/c ratio</td>
<td>low b/c ratio</td>
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<tr>
<td>planning</td>
<td>food processing, heating...</td>
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</tbody>
</table>
Fixed design?
Conclusion

• Encouraging healthy cooking by providing health-related information is feasible
• Long term studies in a real environment

• Design a system in accordance with the problem scopes
Thank You!