六、合作團隊研究

生活科技區域整合中心加盟團隊計畫書

<table>
<thead>
<tr>
<th>加盟主題</th>
<th>Persuasive Kitchen</th>
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| 加盟團隊主要成員 | Hao-Hua Chu, Associate Professor  
- NTU Computer Science and Information Engineering  
- NTU Institute of Networking and Multimedia  
Jane Yung-Jen Hsu, Professor  
- NTU Computer Science and Information Engineering  
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| 參與模式         | Open Lab  _x_情境展示  _x_使用者測試  __市場探索  
Virtual Lab  __情境展示  __使用者測試  __市場探索  
其他參與模式 ______________ |
| 計畫簡述         | As a daily activity, home cooking can be viewed as an act of care for family members. However, during cooking process, family cooks are commonly unaware of how many calories go into their prepared meals. This may have the undesirable effect of their family members over-consuming calories. This work proposes a smart, persuasive kitchen, embedded with Ubicomp technology, to improve home cooking by tracking and bringing awareness of the number of calories of food ingredients used in prepared meals. Our kitchen has weight and camera sensors to track the number of calories in food ingredients. Then, through a glanceable peripheral display, our kitchen hopes to persuade family cooks for healthy cooking by informing them about nutritional implication of their cooking habit during every step of their meal preparation process, enabling them to strive for an ideal balance between health and taste. |
| 既有成果         | We have the following existing projects which are related to using Ubicomp technology for behavior persuasion and related to eating.  
Persuasive Tray: It is system to assist occupational therapists and parents in reducing poor eating behavior in young children. The Playful Tray is embedded with an interactive game played over a weight-sensitive surface of a food placemat, which can recognize and track the natural eating actions of children in real time. Child eating actions are then used as game inputs to play a penguin fishing game. |
| 預期成果         | Replicate a working persuasive kitchen inside the OpenLab.  
Conduct pilot user study of persuasive kitchen inside the OpenLab to measure how bringing calorie-awareness affects people’s cooking behaviors.  
Replicate the Persuasive Tray system in the OpenLab. |

（一）過去研究成果

Dr. Hao-Hua Chu and Dr. Jane Hsu are both the leading researchers, with international visibility, in the
ubiquitous computing (UBICOMP) as well as in persuasive technology applied in the smart home and everyday living setting. Their research team has extensive experiences in working on projects that successfully combine technology, design, and human factors together. Dr. Chu also taught UBICOMP at NTU. Below lists some related projects sponsored by NSC Taiwan or industries.

- NSC Taiwan, NTD 7,170,000, 8/2007–7/2010, “iCare2.0: Enabling next generation e-services for digital living”
- NSC Taiwan, NTD 8,907,000, 11/2007-10/2009, “Development of wireless sensor network common platform and demonstration on smart living space and environmental safety”
- NSC Taiwan, NTD 22,078,000, 11/2005-10/2008, “Human-centric robot-assisted recovery environment”
- NSC Taiwan, NTD 1,716,500, 10/2004-9/2007, “iCare community-supported intelligent care for successful aging in place”
- Quanta computer and NSC Taiwan, NTD 19,677,320, 8/2004-10/2006, Industrial-academic collaboration project: experience fusion: secure and scalable human centric computing”
- III Taiwan, NTD 500,000, 4/2005-12/2005, “Enhancing personnel safety with location tracking and person-object interactions using RFID technology”

Below lists some of the related research projects on ubiquitous computing and persuasive technologies:

- Dietary-aware dining table: it embeds a dietary tracker to monitor food consumption of table participants over the dining table. This supports natural user interaction with digital services, enabling users to access digital services without physically using any digital devices.
- Playful/Persuasive Tray: it is an interactive, persuasive game built into an ordinary lunch tray to assist parents to improve dietary behaviors of their young autistic children. The smart lunch tray incorporates both the context-awareness and the interactive media, enabling the creation of a smart object that is not only aware of human behavior but can also influence and shape human behaviors through their natural interactions with the object.
- Playful/Persuasive Toothbrush: It is about a playful toothbrush to assist parents in motivating and getting their young children into a habit of proper and thorough tooth brushing. Our system includes a vision-based motion tracker that recognizes different tooth brushing motions, and a fun tooth brushing game in which a young child clean his/her mirror dirty virtual teeth by physically brushing his/her own teeth.
- Geta sandals: This system embeds a footprint-based indoor location tracker inside a pair of Japanese sandals to track the indoor position of user walking with the sandals. It is one of the first indoor location tracking systems that require no infrastructure support and setup.
- Adaptive RIP system: It is about enhancing the accuracy of radio interferometric positioning (RIP) system by adaptively selecting the best set of beacon nodes for locating a set of mobile targets. To realize this adaptive RIP system, we have developed an estimation error model to predict positioning error of the RIP algorithm given different combinations of beacon nodes. Building upon this estimation error model, we further devise an adaptive algorithm that finds the optimal beacons that give a smallest amount of positional error to a set of mobile targets.
- Energy-efficient Zigbee localization: It is an energy-aware indoor localization system based on Zigbee radio sensor network. Given a request for a certain positional accuracy from an application, it can meet this request while minimizing energy consumption on a target mobile badge. Our method is to adapt the sampling rate to the target's mobility level. Our localization method is based on combining signal strength fingerprinting and signal strength propagation model, optimizing it for Zigbee radio characteristics. We have created several real testbed deployments, and we have shown that energy saving can be as high as 50%.
- Object location tracker: Do you have any frustrating experiences in which you forget where you last placed things, such as glasses, cell phone, wallet, keys, remote controls, etc.? This is an object locator that can automatically track whereabouts of objects you have misplaced by hands, so you won't waste your time looking for misplaced objects. This system is composed of (1) a finger ring RFID antenna, (2) a wrist band connecting the RFID reader to a Zigbee radio sensor node, (3) RFID tags on tracked objects, and (4) any choice of an indoor localization system (see the energy-efficient Zigbee localization above).
Dr. Chu and Dr. Hsu have also published at some of the highest quality computer science research forums, including ACM CHI 2008 (the first paper from Taiwan in 25 years), AAAI 2007 (the first oral paper from Taiwan), UBIComp 2007 (the first paper from Taiwan), Pervasive 2007 (the first papers from Taiwan), etc. They have published over 100 papers, 18 U.S. and Taiwan patents.

On the impacts of their research, their previous research work (the DSRT system) has been adopted in Microsoft Windows Vista Kernel (Multimedia Class Scheduler) and Globus Grid Computing Project, which are currently running on millions of desktop and workstation PCs around the world.

（二）與區域中心合作之內容

Obesity and overweight are major contributors globally to serious diet-related chronic diseases, including cardiovascular disease, hypertension and stroke, diabetes and others [1]. To prevent obesity and overweight, special care should be taken to maintain the calorie content of every meal within daily requirements [2,3]. Packaged foods sold in grocery stores have nutritional information (Nutrition Facts [4]) including number of calories. However, a recent study has indicated that most people still favor home cooking or cooking meals from scratch [5]; in Europe, 52% and the US, 44% of people prefer scratch cooking. Average family cooks may not know how many calories are in their cooked meals after raw food ingredients are mixed and cooked, or whether these meals are considered healthy and offer a good number of calories for their family members [6,7]. One of the reasons is that the average family cook cannot easily follow the steps of calculating calories during an intense cooking activity: first they have to estimate accurately the amount (weight) of each food ingredient used (such as oil, meat, vegetables and others), and then they have to look up a food calorie table to calculate the overall number of calories after cooking and mixing several ingredients in a course or a meal.

Figure 1. Calorie-aware Kitchen with calorie tracking and digital feedbacks of nutritional information during cooking process

This study presents a Calorie-aware Kitchen that can provide family cooks with awareness on the number of calories in their home cooked meals, thus help family cooks make healthy meals with the appropriate amount of calories, as recommended by nutritionists.

Figure 1 depicts the Calorie-aware Kitchen. It is augmented with sensors that track the food ingredients used during cooking, and provides just-in-time digital feedback to raise healthy cooking awareness. For instance, when a user prepares a meal, the kitchen presents calorie information whenever the user performs a cooking action that changes the amount of food ingredients on the kitchen counter or the stove, such as by adding meat, pouring in oil, etc. Given the number of calories of each ingredient, an average family cook can reconsider the amounts of ingredients or the composition of a course, to achieve a good balance between healthy and delicious cooking. The developed kitchen also suggests the recommended number of calories for a meal, based on the Harris-Benedict equation [8], for the entire family.
BACKGROUND

Prior to describing our kitchen system, causes of obesity and conventional calorie control methods must be understood; the target users defined, and the results of a contextual inquiry into target users’ cooking behaviors introduced.

Obesity Concerns and Calorie Control

According to studies [1,9], obesity is caused by an energy imbalance, i.e. energy intake exceeds the energy expenditure. Every excess 7000 kilocalorie (kcal) may result in a weight gain of 1kg. Therefore, a major solution to weight gain is calorie control [10,11,12].

In practice [13], nutritionists have educated the public about the effects of an over-intake of calories on obesity and chronic diseases, as well as the importance of monitoring the amount of calories consumed. However, the traditional approach is usually ineffective on home cooking, as the knowledge of nutritionists cannot be easily put into cooking practice, for many reasons. (1) Nutrition education often occurs through the media, such as TV or newspapers, which do not present for the real context of consumers’ real cooking place (kitchen). This non real-time, non in-situ education is not effective and is often ignored by family cooks when they really cook in a kitchen [14,15]. (2) Most individuals do not find nutrition easy to understand, and they find the calculations too complex and time-consuming [10]. (3) Family cooks are more reluctant to change their cooking habits, given that they have cooked for a lifetime, unless they have a very strong motivation, such as personally experiencing obesity and related diseases.

A more effective solution is demanded. This study specifically targets family cooks and their kitchens, which are the main sources of meal/food production. Calorie-aware cooking by family cooks may result directly in healthy, light-calorie eating by their family members and prevention of obesity problems.

Targeting Experienced Family Cooks

This work targets experienced family cooks. An experienced family cook is defined as someone who can cook without following any recipes or by relying on weight scales to measure food ingredients. He or she regularly and frequently makes meals for their families over an extended period. Acquired extensive cooking experience also leads to a personal cooking preference for particular compositions and portions of food ingredients in dishes or meals. For instance, an experienced family cook may prefer to add more butter to make tastier fried steaks, or may opt for more oils when stir-frying vegetables. Although such experienced cooks may not be aware of the health consequences of their cooking habits, they are interested in knowing how to make their meals healthier because of their concern and care for family members. Such cooks are our targets.

RELATED WORK

Much research effort [25,26,27,28,29,30,31,32,33,34,35] has focused on augmenting kitchens with various digital media to create rich, interactive experiences for users who are cooking in a kitchen. Some work has focused on increasing awareness to support multi-tasking activities in the kitchen. For instance, the Counter Intelligence project from MIT [25] augmented a kitchen with ambient interfaces to improve the usability of the physical environment. Their augmented kitchen assists users to determine temperatures, find things, follow recipes and time steps during meal preparation. Other work has focused on digital interactive recipes that guide users through a step-by-step cooking process. For instance, Siio et al. [26] automated the creation of web-ready multimedia recipes in a kitchen. By operating a foot switch, a user can capture images of the cooking workplace with voice memos and organize a multimedia recipe. Such digital recipes offer a more interactive experience than a paper-based recipe book. The CounterActive project [27] uses a digital functionality to teach people how to cook by projecting multimedia recipes onto a touch panel-like interactive kitchen counter. Also, the Intelligent Kitchen project [28] presents a human activity recognition system in the kitchen, using data mining to infer the next human action from past behaviors, and then suggesting what to do next using an LCD and a robot.

Rather than augmenting kitchens with a range of digital media to create interactive cooking experiences, our smart kitchen focuses on promoting healthy cooking by raising nutritional awareness during the cooking process, while leaving the decision about how to cook to the users.

Work and commercial products [21,36,37] have exploited ubiquitous computing or mobile devices to record personal food intake and calories. The Dietary-aware Dining Table [21] can track what and how much users eat on the dining table. Work from Mankoff et al. [36] tracks nutrition of foods users have
taken and provides suggestions about healthier foods based on analysis of shopping receipt data. IE Institute Co. [37] developed software “Calorie Navi” running on Nintendo DS [38] that can help user record food intake of 300 types of foods and exercise level. However, they focus on tracking and recording food intake itself; therefore differ from our work, which focuses on raising nutritional awareness on preparing and cooking foods in the kitchen at home for all family members.

**CONTEXTUAL INQUIRY**

Before the smart kitchen was designed, a four-day contextual inquiry was conducted to understand the cooking behaviors of four experienced family cooks (aged 28, 30, 58 and 65) in their home kitchens as they were cooking a regular dinner for their family. During the cooking process, they were observed and videotaped; notes were taken, and questions asked about their cooking process, meal preparation, understanding to nutrition and calorie control. The findings are as follows.

- Family cooks commonly added ingredients based on experience or preference (oil, butter, meats, for example). Most stated that they were unsure about whether their own cooking styles were healthy. However, they mentioned that they would alter their cooking style when their cooking styles may result in health-related concerns of family members, such as gaining weight. They would also perform their own trial-and-error runs to strike a balance between health and taste.

- They expressed the desire to cook healthily for their family members, especially with respect to calorie control and nutritional balance. However, given busy schedules, they could not afford too much time or make much effort to learn and follow the complicated steps of weighing food ingredients and calculating nutritional values during actual cooking. They preferred simple-to-understand, practical guidelines that are relevant to their cooking styles.

- Since cooking is a real-time activity that requires ongoing planning and thinking about the next cooking step, family cooks would like to focus solely on cooking. They do not like to be distracted and interrupted by unrelated activities, such as answering phones, taking care of crying children, and others, because distractions and interruptions are likely to cause cooking errors. They suggested that they want only simple, highly relevant information on cooking or nutrition.

They regard a kitchen as part of a home and not a place of work. No standard procedure should tell them how to operate various tools in a kitchen to produce meals. They want to choose freely whatever methods they are comfortable with to produce healthy and delicious meals. Many also view cooking as an enjoyable activity, which brings them satisfaction and happiness, especially when they receive positive feedback about delicious meals from their family.

**DESIGN CONSIDERATIONS**

The contextual inquiry led to the following design considerations in designing the Calorie-aware Kitchen: (1) a kitchen should offer just-in-time calorie information on food ingredients and dishes during their regular cooking process, to reduce greatly the effort required to calculate calorie manually and help family cooks with controlling calories. (2) Information should help family cooks make their own decisions regarding the balance between health and taste, without constraining his or her natural cooking habits. When cooks must concentrate, they can choose to ignore the informational display. (3) Information should be presented simply, and the layout of the information should mirror actual usage and actions, so that family cooks can easily grasp the calorie information by taking quick glances. (4) Calorie recommendations should be provided for ease of comparison and adjustment. (5) Feedback should be offered playfully to make the complete cooking process enjoyable.

**PROTOTYPE DESIGN**

Based on the above design issues, an initial prototype of the kitchen was proposed, and is presented in Figure 1. The kitchen is a standard one purchased from IKEA [16], comprising the following two modules; (1) a calorie tracker that tracks the calorie, composition, and position of food ingredients and dishes that are currently on the kitchen counter or stove; and (2) an awareness display that provides calorie information on the ingredients and dishes, with a calorie-aware game brings enjoyment to the process by which users control calories to meet recommendations. Users can operate the system according to the flow shown in Figure 2. The following two sections present these details.
CALORIE TRACKER

Whenever a user performs a cooking action (adding or removing ingredients to or from a container) that may change the number of calories during cooking, the system must detect the cooking action as a calorie-change event in real-time. An example of such cooking actions is the addition of salad oil (130 kcal) to a pan or the removal of bacon (250 kcal) from a cutting board. Studies have shown that the number of calories can be derived from the sum of the calories of all the used ingredients and calories can be derived from weights of ingredients [17]. Therefore, to track calories, only the weight and the composition of food ingredients in dishes need to be determined.

The calorie tracker offers a hybrid sensing solution by combining weighing sensors and computer vision for accurate detection. Figure 3 depicts the architecture, which comprises hardware components (weighing-sensing surface and camera sensing) and software components:

Hardware Design and Implementation

Weighing-sensing surface

Based on our observations of cooking activities, most main food preparation activities occur on the kitchen counter. They include putting ingredients on a plate, transferring foods among containers, cutting foods over a cutting board, mixing in a bowl and others. Hence, the system must accurately recognize the amounts (weights) of ingredients that are added to each container to calculate their calories. For the prototype, the design was based on the load sensing table [18] that four weighing sensors were installed in the four corners underneath the kitchen counter with an area of 55x44 cm² (see Figure 4 left). All foods ingredients are assumed to be placed in or on kitchen containers (e.g., plates and bowls, cutting boards are also counted as containers here), rather than being placed directly on the kitchen surface. Hence, the smart counter can track the position of the containers on the countertop with an accuracy of 1 cm, and the weight of food ingredients in these containers. On the other hand, most cooking activities are performed on the stove, such as frying in a pan, so a weighing sensor must be present under the stove, too (Figure 4 right). All of the weighing sensors are attached to weight indicators with a resolution of 1 g, which output readings through a serial port at a frequency of eight samples per second.
Camera Sensing

Computer vision is employed to improve the accuracy by filtering noise from the weighing-sensing surface. An overhead camera is deployed over the counter to capture an overview image of the counter (Figure 5). However, the other camera is not installed over the stove because foods over a burner may produce smoke which affects the image processing and damages the camera.

Software Design

The design of our calorie tracker is based on a bottom-up event-triggered approach with three types of event from high-level to low-level. A high-level Calorie-change event describes ingredients and their calorie amount contained within a container. For instance, a Calorie-change event can be (“container1”, “salad oil”, 130kcal), in which the calorie value is calculated by the component calorie calculator, with a nutritional database and middle-level Transfer events. A Transfer event describes ingredients and their weights contained within a container, e.g. (“container1”, “salad oil”, 50g). This is determined by the ingredient inference engine, which tracks the path of each ingredient from a starting container (as when bacon from a fridge is moved to the cutting board) to an ending container which holds the final cooked meal. The engine works with the low-level Sensor events such as (“position:(10,50)”, 50g), detected from the weight change detector.

Weight Change Detector

At the bottom, the weight change detector aggregates weight samples from weighing-sensing surface. It reports Weight-Change events to the food ingredient inference engine when the weight changes, by detecting the stream of weight samples.

However, based on preliminary experiments, detection using only weighing sensors is not sufficiently accurate (recall of 54%, meaning 46 false positive detections or detections of noise per 100 weight changes), especially when cooking actions, such as cutting or stirring, generate lots of weight noise. Observations indicated that when these actions are performed, the cook performs similar motion of foods using hands and/or utensils. For instance, to cut bacon, the cook uses one hand to hold the bacon and the other hand to take the knife, cutting little by little. Therefore, video analysis using a color histogram comparison [19,20] is performed to filter false detections from weighing sensors. Comparing histograms is a good means to reduce sensitivity to the motion of objects that two camera images captured at different times with unchanging objects differ only slightly in their histograms, but a real change can still be detected.
Ingredient Inference Engine

After the weight change detector has reported low-level Weight-Change events (weight and position), the system then uses an inference rule engine to infer middle-level ingredient transfer activities. A weight matching algorithm similar to that in our earlier work \[21\] is adopted to track the transference of food from one container to another. Therefore, when weight change detector detects weight changes, by matching a weight decrease (such as from a food container on a counter) to a weight increase (such as in a pan on the stove), food ingredient transfer is inferred and an Ingredient-Change event is sent to the calorie calculator.

Food Labeling

A Wizard of Oz method that involves one human observer’s manually inputting the name of an ingredient is currently used to identify new ingredients during cooking process, because of the difficulties of recognition using computer vision or RFID tags on raw ingredients. When the inference engine detects a new ingredient that cannot be inferred from the weight decrease of any container, the camera captures an image and show to a human observer to ask its name in the other display that the user does not see. A voice-dialog system is tested to enable family cooks to identify foods using a voice input, for application in the subsequent stage.

Calorie Calculator

After an Ingredient-Change event is received from the inference engine, a public nutritional database that provides the nutritional values of each ingredient is used by the calorie calculator to calculate the number of calories based on the weights and the names of the ingredients \[10\]. This value is reported to the awareness display to interact with the family cook.

Accuracy and Response Time

The accuracy of the tracking of ingredients is important to provide correct calorie feedbacks to users. According to the user study of three participants who cooked a total of 15 meals, the hybrid method achieves a recall of 88%, where major noise is from the weighing sensors under the stove without camera sensing, and currently requires human observers to filter noise manually. The precision is 95%, with missed detection when the weight is too low (less than 1g) by weighing sensors or when camera sensor incorrectly filters the weight change. The accuracy of the calorie calculation is 97%: 97% of the real calorie amounts of ingredients can be determined, where the missing calories are associated with undetected food ingredients. For every cooking event (adding / removing ingredients), the average response time is 1 second, including the detection time associated with weighing, camera sensing and transfer recognition.

Limitations

Since our tracking method is based on weighing sensors, the current prototype has a limitation that it cannot recognize concurrent or interleaving events, such as taking two dishes from a counter simultaneously and then immediately putting the ingredients into the pan on the stove.

PROPOSED REVISION – SIMPLE INFORMATION

Figure 6 presents the proposed revised user interface in the Calorie-aware Kitchen based on the design considerations. The interface has two parts - an overview of the calories in the currently used ingredients, and recommended calorie needs and the total currently used calories.

Real-time Awareness of Calorie in Use

The main part of this interface presents an overview of the number of calories in current ingredients on the stove and counter (Figure 7a), to enable family cooks to obtain information efficiently. Information on containers, including the total amount of calories and the names of the ingredients in it are displayed (Figure 6 right) based on the real position. This information is stronger only when the number of calories exceeds the basic threshold of 200kcal. Otherwise, ingredients with few calories (such as garlic, lemon) are left to allow users to focus on their cooking. All the changes on the interface are made with a short and simple sound to notify users.

Recommended Calorie Needs

In the left part of our UI (Figure 6b), a vertical bar is used to show the recommended number of calories for the meal, which is determined using the Harris-Benedict equations (based on weight, height and age) and the individual activity level \([8,22]\). Therefore, before the system begins, the above details
on the user’s family members are input, and then the system calculates and presents the required number of calories for this family for reference. During the cooking process, the current total calories in use are presented, to facilitate control by the user. Additionally, when a user finishes one course and removes it from the system, the removal is recorded and the number of calories is kept in the bar so that users need not memorize anything.

Figure 6. User interface of Calorie-aware Kitchen, including (a) overview of calorie in the system; (b) recommended calorie needs and current used calories; (c) a calorie-aware game with a beloved family member to bring enjoyment of calorie control

PROPOSED USER STUDY

The following questions will guide our proposed user study in the OpenLab.

- How effective would the Calorie-aware Kitchen in improving the family cooks’ ability to control calories during cooking?
- What cooking behaviors would be affected by the Calorie-aware Kitchen?

We are planning to perform evaluation to determine how the awareness of calories during cooking affects users. The activities in the cooking process are complex, so rather than focus on a specific behavior, a holistic view would be taken to gather both quantitative and qualitative observations.

Proposed User Study Design and Procedure

Since our prototype kitchen would be constructed in the OpenLab, it could not be easily moved to each of the participants’ homes. Therefore, participants will be invited to cook in the OpenLab. A video camcorder will be used to record the participants’ cooking sessions and their interactions with our system; their consent will be obtained for subsequent analysis.

Our user study will involve the following three phases: (1) pretest cooking without feedback on calories, (2) test cooking with feedback on calories, and (3) posttest interview.

To compare the effectiveness of our smart kitchen between pretest cooking and test cooking phases, each participant will be asked to write a fixed dinner menu (Table 3) as if they were to prepare a regular dinner for their family. Then, the participants will be asked to cook meals in the manner that they would normally do at home. In each cooking session, each participant will be asked to cook according to their designated dinner menu in our laboratory kitchen.

In the pretest cooking phase, each participant will cook two meals on two separate days without turning on calorie feedback. Before the start of the first pretest cooking session, the three participants were given time to become familiarized with various appliances and the arrangement of cooking tools in the laboratory kitchen.

Proposed Measurement

To determine how effectively participants cooked healthy meals, this study will first measure healthiness during cooking sessions. The method will count the number of calories in a prepared meal by subtracting the weights of all food ingredients at the end of the cooking session from that at the start of the session. Then, the nutritional database will be used to determine the total calories in every meal.
Second, the change in the ingredients between the pretest and test cooking phases of each participant will be analyzed to understand how participants reduced calories used. Third, the cooking videos will also be analyzed and coded. We hope to collect the following data for each cooking session: (1) the frequency with which a participant glanced at the calorie display following a cooking action that resulted in a calorie change; (2) the average duration of a glance at the calorie display, and (3) the duration of a cooking session. Finally, the posttest interview will involve qualitative measurements of preference, ease of use, future use and comments.

PROPOSED SCHEDULE (工作进度安排)

The proposed 12-month schedule is as follows:

- First 4 months: setup the persuasive kitchen/tray systems in the OpenLab
- Second 4 months: perform user studies on the persuasive kitchen in the OpenLab.
- Third 4 months: evaluate user study results and proposed modifications for the next revision of the persuasive kitchen.

EXPECTED RESULTS (预期效益)

In OpenLab, we will demonstrate a working persuasive kitchen that can persuade family cooks for healthy cooking by informing them about nutritional implication of their cooking habit. The system will include hybrid camera/weight sensing hardware/software, and persuasive interfaces in the form of a glanceable display.

In OpenLab, we will evaluate the effectiveness of our persuasive kitchen on cooking behaviors and give experiences in deploying such technology at home.

In OpenLab, we will duplicate our existing systems on persuasive tray toothbrush systems.

REFERENCES

We need a place to install our persuasive kitchen system. Additionally, we need a water outlet, a 240V electric outlet for the burners, etc. We may also need to install proper ventilation for the smokes.

### 加盟團隊所需預算

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