smoon: A Spoon with Automatic Capacity Adjustment

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Abstract— **People often cook meals while referring a recipe, and following a recipe usually involves frequent measurements of ingredients. The measurement process involves converting numerical data in the recipe into corresponding amounts of physical ingredients, but this process is tedious and prone to error. We devised a means by which a robotic system directly converts numerical data on a digital recipe into physical quantities and built a prototype measurement device called 'smoon'. Smoon is a robotic measuring spoon that physically transforms itself to change its capacity according to recipe data stored in a computer or on the Internet. This system allows the user to cook a meal with a simpler workflow. The user obtains accurate amounts of ingredients simply by scooping: there is no need for him or her to pay attention to the quantity or units specified in the recipe.**

Keywords-component; Measuring; Kitchen; Interaction Design; Physical Computing;

I. INTRODUCTION

Today, vast amounts of knowledge are stored and shared on the Web. We can now obtain a variety of information on the Internet anytime and anywhere by using a mobile device, and we can perform various tasks using such information. For example, if you want to cook something, you can find a huge number of recipes on recipe websites. However, this digital cornucopia stops at the border between the digital and real world; i.e., the cooking itself is not automatic, and we have to physically cook a meal by ourselves. In other words, the information on the net (e.g. recipe) has to be transformed into a physical entity (meal) indirectly through manual labor (Figure 2). This indirect process makes such transformations inaccurate and tedious.

Our goal is to develop a computational device that converts data on the net into a physical entity directly with as little human intervention as possible (Figure 1). In this paper, we present a novel measuring device called smoon (smooth + spoon) (Figure 1) that frees the user from making manual measurements as an initial experiment toward achieving this goal. Smoon automatically adjusts its capacity based on the provided recipe data, and users can measure out accurate amounts of ingredients simply by scooping: there is no need for them to pay attention to the quantity or units specified in the recipe.

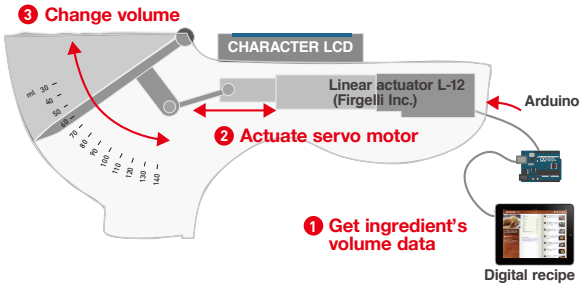

Figure 1. Structure of smoon. An actuator physically changes the volume to match digital recipe data.

II. RELATED WORK

Various kitchen projects using information technology have been undertaken in the field of human-computer interaction. For example, navigation systems for cooking are very popular topics of study [1, 2, 3, 4, 5]. These systems teach the user the next action at the appropriate timing and allow them to share the context with others by showing information with a projector or embedded LCD display in the kitchen. These are navigation techniques that make the user understand the procedure and cook a meal efficiently. However, they do not assist users physically, and users need to perform all of the physical actions by themselves.

III. PROTOTYPE OF SMOON

Smoon is a robotic measuring spoon that physically transforms its capacity in accordance with recipe data stored in a computer (Figure 1, 3). The recipe can be obtained from the Internet. The current prototype is a modification of Nuscup, an adjustable measuring spoon developed by Dalla Piazza Inc. [6]. We used a 17-cm spoon and embedded in it a linear actuator L-12 (Firgelli Technologies Inc.) to change its capacity. In addition, we attached a LCD character display (LCD104B6B) to smoon. The actuator and LCD are controlled by a microcontroller Arduino. Smoon also has a button on its side to control the recipe. In this implementation, smoon is capable of measuring 0 ml to 120 ml of ingredients. It takes approximately 7 seconds to change its capacity from 0 ml to 120 ml.

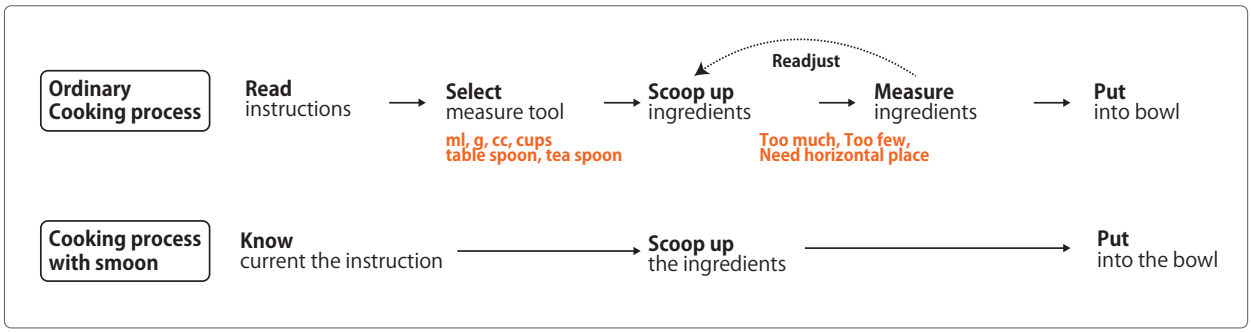

Figure 2. Comparison of cooking workflow with and without smoon

A. *Smoon recipe*

Smoon allows the user to perform measurements without any additional effort, but it does not free the user from having to pay attention to timing or order. We therefore implemented the smoon recipe application on a tablet computer (Figure 2). The smoon recipe is a slideshow application that shows the cooking process step by step. The main feature of this recipe system is that it divides a cooking procedure into individual steps of putting ingredients or materials in pots and pans and shows each step as a slide in order to link smoon to the recipe. Smoon only shows minimal recipe instructions to the user. For example, it only shows "Pour milk into the bowl", and it does not show amounts or units such as grams. Moreover, a Smoon recipe is capable of handling ingredients whose amount is specified by mass. For example, whereas wheat flour and sugar are usually measured by mass, smoon can only measure volume.

To solve this problem, a smoon recipe automatically converts mass into volume. Smoon can measure various materials in this way. In addition, if the total amount is more than a single scoop, the system automatically computes how many scoops are necessary and presents the information to the user. For example, if the user needs to obtain 300 ml of ingredients, the smoon recipe asks the user to scoop three times while appropriately changing its capacity (100+100+100). In the current implementation, the developers manually made the recipe data and converted units. Our future work will be to convert arbitrary cooking recipes on the Internet into smoon recipes.

Figure 3. The "smoon" system. The user does not need to care about the amounts of the ingredients since the recipe data actuates the measuring spoon directly.

B. *Workflow with Smoon*

Smoon skips tedious actions in a cooking workflow. Figure 3 compares cooking workflows with and without smoon. A notable point in the smoon workflow is that the users simply scoop the material into a pot or pan and no additional actions are necessary. The user does not have to think about the amount of ingredients or the units.

IV. CONCLUSION

We developed a robotic measuring spoon called smoon. Here, we described the current implementation and its recipe system. Smoon simplifies the process of cooking using digital recipes. The main idea behind this work is to convert digital data directly into physical entities to be used in physical tasks. Cooking was just an example. We plan to explore this idea further in other domains in the future. For example, we could explore the use of a smart screwdriver that changes its size and shape from plus to minus based on instructions given in assembly manuals.

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