Ubiquitous Computing for Improving Daily Behaviors

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With the commoditization of devices, networks, or sensors, ubiquitous computing in everyday life has become common, and various types of research related to ubiquitous computing have been proposed. Among the daily behavior, this thesis focuses on the human eating behavior, which is directly related to our health and the dietary education activities of children, which has recently become an important issue. This thesis also aims to systematize the realization of ubiquitous computing system that supports dietary education in fun-filled activities at home as well as its design approach. It then recommends to involve three necessary elements, called 3A ELEMENTS, namely, Acceptability, Attractiveness, and Agreement, for a persuasive system of behavioral improvement in daily life. In addition, it emphasizes the importance of considering these three elements in developing the system configuration. This thesis briefly defines each element. Acceptability means that the system is accepted by the users in their current normal lives. Attractiveness refers to motivating the users to use the system. Agreement means that users agree with and adopt the system or the behavioral improvement objective. According to this approach, the author developed two kinds of systems to improve the eating behavior of children in a natural manner in an actual home setting without them being aware of the technology. To enhance the acceptability of the system, the author embeds the main technological components into a common eating utensil: the fork. In addition, most children often have little or no incentive to change their eating behavior. Therefore, by providing highly attractive feedback corresponding to the eating habit of a child, the author aims to motivate children to use the system. Furthermore, when the system performs as a persuasive tool, the children will agree and adopt the system. From the experience a child acquires from the system relative to his/her own eating-related behavior, the author believes that the system will finally lead to behavioral improvement.

Before designing Ubicomp devices to support dietary education, it was important

to explore the current state of dietary education. To do so, the author conducted an investigation with the mothers of children from a kindergarten. The author determined the mothers were primarily concerned with particular eating habits common to many children. These included a stubborn reluctance to the foods that children disliked, the unbalanced diets of children adverse to different types of food, and the susceptibility to distraction in children who do not concentrate on the meal itself. Therefore, based on the 3A ELEMENTS, the author proposed two systems to resolve these eating problems and conducted user studies in actual homes, resulting in various findings.

The first system is a fork-type device, called EaTheremin, aimed mainly at addressing problems stemming from foods that children dislike. When a user eats food using the EaTheremin, it generates a funny sound. The second system is another fork-type device, called the Sensing Fork. This device was mainly targeted at improving unbalanced diets. The Sensing Fork contains numerous sensors and modules, and it is able to work with smartphones via a Bluetooth module. Furthermore, the Sensing Fork detects the color of the food consumed by the user, and can recognize whether the device is At-Rest, Holding, Poking, or Biting. In addition to the development of technology that detects the user's eating behavior, the author also designed a smartphone application, called Hungry Panda, to promote dietary education.

The two fork-type devices were successfully implemented in a real environment. Without any significant modifications to the status and dietary behavior of children in the home, the system persuaded children to eat foods they disliked and to achieve balance in their diet. Moreover, because the devices were entertaining, they had a certain effect on children prone to distraction as well. This thesis explored improvement in children's eating habits at home, and its effects on users' consciousness and action.