MAMAS: Mealtime Assistance to Improve Eating Behavior of Children Using Magnetometer and Speech Recognition

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ABSTRACT

Children's problematic eating behavior is one of the biggest problems parents suffer from. Even though the role of parents in building children's eating habit is critical, it is very difficult for parents to continue on the positive interaction with children during mealtime. We describe our preliminary study to develop a system that provides systematic analysis of parent-child mealtime interaction, so as to promote children's healthy eating habits. We propose an application called MAMAS, a mealtime assistant using magnetometer and speech recognition, which 1) noninvasively tracks mealtime interaction patterns, 2) augments analysis with self-reported data and quantification, and 3) provides data-assisted analysis for parents' self-reflection.

Author Keywords

Children, eating behavior; assistive technology; noninvasive sensing; magnetometer; speech recognition; semi-automated tracking; persuasive technology.

ACM Classification Keywords

K.4.2. Computers and Society: Social Issues; H.5.m. Information interfaces and presentation (e.g., HCI) : Miscellaneous.

INTRODUCTION

Childhood eating problems such as not eating enough, refusing to eat certain foods, throwing or intentionally dropping food are prevalent. Eating problems are observed in 80% of children with developmental disorders and 20% to 50% of those without [1]. Parents of young children have felt stress from their children's inappropriate mealtime behavior and felt fear of growth deficiency [2]. There have been various assistive technologies that target children to promote healthy eating habits by entertaining them [3,4,5,6]. However, these methods did not consider establishing positive parent-child interaction during mealtime, which is reportedly one of the fundamental factors in forming children's mealtime habits [8,9]. Furthermore, parents' own challenges and needs are yet to be addressed. Our aim is to develop a prototype of an assistive mobile application that

can provide systematic analysis of parent-child mealtime interaction, so as to improve on children's mealtime habits. We do not address children directly. Rather, we seek to provide noninvasive tracking data to help parents better understand the context of mealtime interaction and encourage them to change attitudes toward their children. To do this, we conducted a survey on 78 parents and semi-structured interview with three child behavioral experts in South Korea. Drawing on the formative user research findings, we propose a prototype of MAMAS, a mealtime assistant application using magnetometer and speech recognition.

FORMATIVE USER RESEARCH

Participants and Methods

The 78 parent survey respondents were raising 'picky-eating' children, whose ages ranged from 1 to 6. All expert interview participants were individuals who had regularly consulted with children displaying problematic eating behaviors and their families for several years. Survey questions for parents included general information, challenges, behavioral patterns, and sentiments regarding mealtimes with their children. Interview questions for our three experts included major factors in mealtime habit formation. We then suggest three design guidelines by synthesizing findings from the formative studies.

Design Guidelines

Providing Support and Encouragement to Parents
Parent respondents were sparing a quantity of time to build healthy eating habits of their children. However, they were depressed and pessimistic on their own educational methods which are mostly based upon their speculation. First, their educational methods were not effective enough to change their children's eating habits. Second, such methods had negative effect on mealtime conversation and overall parent-child relationship.

Promoting Parents' Positive Feedback
Both our survey and interview results revealed that parents' meal-time educational behavior could be a critical factor of forming children's eating habits. According to expert participants, a critical part of clinical sessions consists of improving parents' language habits. Nevertheless, over 60% of the respondents replied that they had expressed negative feelings (e.g., anger) on their children during mealtime. Consequently, parent-child interaction during mealtime was falling into a vicious circle.
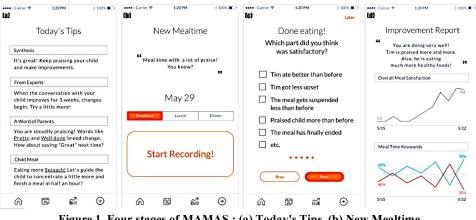
Figure 1. Four stages of MAMAS : (a) Today's Tips, (b) New Mealtime, (c) Self-reporting questionnaire, (d) Improvement Report

Restricting Sensory Stimuli during Mealtime

Preexisting systems trying to solve children's unbalanced eating habits concentrate on delivering playful mealtime experience using various media such as interactive feedback [3,4,5]. However, all expert claimed that children should not be exposed to external media such as handheld screen, so as to avoid distraction [7].

THE DESIGN OF MAMAS

To promote children's healthy eating behavior and positive interaction during the mealtime, we developed a smartphone-based mealtime tracking system, called MAMAS. MAMAS automatically tracks intake behavior and verbal interactions during mealtime, then collects self-reported data after the meal. It also provides systematic analysis to help parents reflect on how a meal unfolded. We chose a mobile platform because of its high accessibility, instant data logging functionality, and wide variety of sensors embedded.

MAMAS Feature Description

In general, MAMAS functions under three steps: (1) noninvasive tracking of mealtime behaviors; (2) supplementary data collection by self-reporting; (3) data-assisted self-reflection on mealtime interaction.
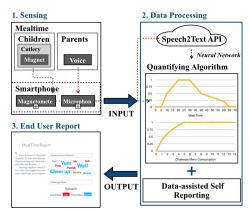

Figure 2. System Block Diagram of MAMAS

Noninvasive Tracking of Mealtime Behaviors

This stage tracks two main behavioral patterns using two noninvasive tracking methods (Figure 1.(b)). First, using smartphone magnetometer, MAMAS tracks a child's intake pattern on the 'challenge menu.' 'Challenge menu' indicates a healthy menu that a child may resist. Parent attaches a little magnet on the grip part of the child's cutlery and places a smartphone around the top of the child's dish. Second, MAMAS records parents' language habit during mealtime. When a parent speaks, his/her utterance is converted into texts using speech-to-text API. MAMAS maintains a corpus of desirable and undesirable keywords that may appear in one's mealtime speech. Two indices are collected noninvasively so as not to distract children from the foods (Figure 1).

Data augmentation with Self-reporting and Quantification

By asking short follow-up questionnaire to parents, MAMAS backs up the credibility of tracked data. It also investigates the parent's satisfaction level which cannot be tracked by sensors. In the end, the parent gets quantified measurement of each mealtime data analyzed by our algorithm. Using this algorithm, MAMAS quantifies mealtime duration, speech data, and the number and interval of each menu's consumption (Figure 1.(c), Figure 2).

Data-assisted Self-reflection on Mealtime Interaction

This stage intends to provide opportunity for self-reflection, with practical guidance on how to improve problematic mealtime interaction patterns. The reports come in two types: one offering review of every meal and the other showing long-term changes. A report first offers brief sentence-form summarization of key points. Sentences are formed intentionally with sympathetic and encouraging tone. Detailed visualization of quantified mealtime behaviors follows. For long-term reports, parents can review improvements on language habits and consumption of each 'challenge menu,' visualized by line charts (Figure 1.(d)).

CONCLUSION AND FUTURE WORK

Based on formative findings, we suggest MAMAS, which is a noninvasive mobile-based application for assisting parent-child interaction during mealtime. We have implemented an early working prototype with partial functionality, and aim to present an integrated working system at the demo. In the near future, we will evaluate the fully working prototype with parents with picky-eating children, deploying the system for long-term in-situ evaluation.

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