

LITERATURE SURVEY

JOURNAL PAPERS AND INFERENCE

TITLE: Effects and challenges of using a nutrition assistance system: results of a long term mixed-method study

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Healthy nutrition contributes to preventing non-communicable and diet-related diseases. Recommender systems, as an integral part of Health technologies, address this task by supporting users with healthy food recommendations. However, knowledge about the effects of the long-term provision of health-aware recommendations in real-life situations is limited. This study investigates the impact of a mobile, personalized recommender system named Nutrilize. Our system offers automated personalized visual feedback and recommendations based on individual dietary behaviour, phenotype, and preferences. By using quantitative and qualitative measures of 34 participants during a study of 2–3 months, we provide a deeper understanding of how our nutrition application affects the users' physique, nutrition behaviour, system interactions and system perception. Our results show that Nutrilize positively affects nutritional behaviour measured by the optimal intake of each nutrient.

The analysis of different application features shows that reflective visual feedback has a more substantial impact on healthy behaviour than the recommender. We further identify system limitations influencing this result, such as a lack of diversity, mistrust in healthiness and personalization, real-life contexts, and personal user characteristics with a qualitative analysis of semi-structured in-depth interviews. Finally, we discuss general knowledge acquired on the design of personalized mobile nutrition recommendations by identifying important factors, such as the users' acceptance of the recommender's taste, health, and personalization.

The research in recommender systems has been recently interested in food recommender systems addressing, among others, nutritional health with different approaches (Trattner and Elsweiler [2018](#)). These systems have the potential to help users navigate the growing amount of multimedia food content (Min et al. [2019a](#)) while fostering healthy eating patterns. Conventional recommender systems learn the users' preferences and try to cater to them, which might enforce recommendations for unhealthy food as well (Elsweiler and Harvey [2015](#); Schäfer et al. [2017b](#)). Thus, health-aware recommender systems need to also incorporate different parameters related to taste and health into their systems (Elsweiler et al. [2015a](#), [2016](#); Ge et al. [2015a](#)). The use of nutrition assistance systems is promising since previous studies have shown that persuasive technologies can help people to eat healthier (Orji and Moffatt [2016](#)). Existing national and international dietary guidelines constitute important informational sources for nutrition (Painter et al. [2002](#)) but are often based on guidelines for a whole population instead of dealing with individual requirements.

Yet, efforts towards personalised nutrition recommendations have been made by Zeevi et al. (2015) and within the Food4Me study (Celis-Morales et al. 2015). Zeevi et al. (2015) incorporated different individual aspects into their algorithm based on machine-learning techniques like dietary behaviour, anthropometrics, blood biomarkers and the gut microbiome. Based on this, they could successfully predict the post-prandial glucose response (PPGR) that varies greatly between different individuals for the same meal. Celis-Morales et al. (2015) examined in their 6-month study the effectiveness of personalized nutrition advice, which was based on dietary, phenotypic and genotypic information. Their results showed higher effectiveness in changing nutrition habits through personalised dietary advice than conventional dietary advice.

Evaluations of recommender systems often focused on measuring algorithmic accuracy, which is insufficient in explaining user experience (Knijnenburg et al. 2012). Further, studies on recommendations and mobile applications frequently cover short-term usage, i.e. think-aloud lab studies of multiple hours or surveys comparing recommender algorithms on a quantitative level. Especially in the context of health recommender systems, it is important to not only evaluate recommendation accuracy. Since healthy recommendations might contrast user preferences, it is crucial to evaluate user satisfaction and changes in behaviour and health over a longer period of time, i.e. multiple weeks, (Schäfer et al. 2017b). Traditional nutrition interventions require months to show lasting effects on nutritional behaviour and physique. Therefore, we evaluate our proposed system, *Nutrilize*, based on a 2–3 months study using a mixed-methods evaluation of the system effects and the user experience.

It is our goal to show how long-term usage of a nutrition assistance system influences the users'

- (a) physique,**
- (b) nutrition behaviour,**
- (c) system interaction and**
- (d) system perception.**

Furthermore, we want to gain insights into the reasons for observations appearing in long-term but not in short-term usage by analyzing semi-structured in depth interviews.

The Nutrition Care Process

1. Nutrition Diagnosis

- Identify & label problem
- Determine cause/contributing risk factors
- Cluster signs & symptoms/defining characteristics
- Document

2. Nutrition Intervention

- Plan nutrition intervention
- Formulate goals & determine a plan of action
- Implement nutrition intervention
- Care is delivered & actions are carried out
- Document

3. Nutrition Monitoring & Evaluation

- Monitor progress
- Measure outcome indicators
- Evaluate outcomes
- Document

4. Nutrition Assessment & Re-assessment

- Monitor progress
- Measure outcome indicators
- Evaluate outcomes
- Document

TITLE : Personal Health Assistant on Android Mobile Device: Sleeping, Nutrition and Exercise

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Good health can be achieved by maintaining good behaviors such as a good night sleep enough exercise and good nutrition. However, the competitive environment nowadays prevents such good behaviors. Thus, this work aims to develop an application on mobile devices that is able to (1) record the daily sleeping, exercise and nutrition information, (2) analyze the collected information in order to provide a notification or an alarm, and (3) present the analyzed results in a simple and easy to understand format. The proposed application can collect data from other application and from the users. A set of simple data analysis methods is performed on the collected data in order to provide a personal health advice based on the user pre-defined preferences.

Better health can be achieved by maintaining a simple lifestyle such as a good night sleep, enough exercises and good nutrition. People spend one third of their lives sleeping however most people do not understand the importance of sleep. Moreover, the lack of sleep can

affect a person's memory and emotion. The exercise habit and nutrition can also lead to good health. Daily working life can be affected by lack of sleep such as drowsiness and long-term health problems [1,2]. Many researches have shown that not enough sleep or exercise can lead to many health problems such as GERD [3], Alzheimer's disease [4], heart disease [5], sleep apnea [6] and insomnia [7].

In the competitive work environment, nowadays, it is not easy for many people to manage good sleeping and exercise habits. With busy work and personal life schedules, many people indulge themselves in a bad sleeping habit such as sleeping very late or waking up very late especially in young adults and teenagers. A good night sleep can also be affected by the person's exercise habits and nutrition consumption. The sleep, nutrition and exercise have more complicated relationship than many people have realized [8]. Enough exercise helps people sleep better and good nutrition also lead to better mood and better health. Thus, a that can automatically record personal information, produce a warning, and give personal advices to its owner in order to maintain good sleeping, exercise and nutrition habits is needed.

Today smart phone technology is a good candidate for this project because of its low cost, portability and capability which is similar or close to a personal computer. Moreover, a phone has become a typical device in daily activity. In addition, a current smart phone includes a lot of sensors such as an accelerometer, a microphone and a light sensor. These features make a smart phone suitable for collecting personal data in this work. Android is a Linux-based operating designed for touch screen mobile devices.

Lately, Android becomes the world's most widely used smart phone platform [9]. Especially, its customizable features allow Androids to be the software of choice for many developers.

Thus, this project aims to develop an application for Android smart phones that has a capability to record the information related to the amount of nutrition consumed, to analyze the collected data and provide a notification or an alarm in order to suggest or remind the user in taking care of his/her health; and to present the analyzed results in a format that is easy to understand without the need of a deep medical knowledge.