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Nutrition Management and Diet Monitoring Information System

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Abstract: A Nutrition Management System currently deployed in the cafeteria of a consumer electronics manufacturer provides a low-salt diet program to factory workers for disease management. However, the existing system lacks an alert system feature to manage the correct meal plan and the delayed in reporting it. Additionally, the current program also lacks expert nutritionists who can determine the appropriate nutritional and dietary compositions. This study aimed to design a more efficient and complete model for Nutrition Management and Diet Monitoring Information System, closely based on nutritional guidelines and applications implemented at health care facilities. The model is a food serving system with an expert component enhanced with a meal registration system via contactless smart cards.

Key words: Nutrition management, diet monitoring, information system, food composition, alert feature

INTRODUCTION

A consumer electronics manufacturer employs ~2,000 workers who are divided into a number of divisions each with a rotation of three shifts. The sizeable number of workers and the need to monitor their health led to the manufacturer's decision to retain a partnership with a health care provider to maintain the workers' health and productivity.

The factory workers are advised to visit their physicians regularly for routine medical examinations. However, from a preventative perspective, a company could provide the workers with a more personalized healthcare program, e.g., through their diet. Through this program, the workers would receive feedbacks on their health which leads to saving valuable time, satisfying their desire for personal control over their own health and lowering the cost of long term medical care disease treatment (Shahriyar *et al*., 2009). Effective health care management requires a strong collaborative partnership between patients and their medical care team. Obstacles to building an effective partnership between patients and the team include the lack of patient time and active involvement, low level of continuity in routine care, limited patient self-monitoring of symptoms and minimal follow-up in between visits by the care team (Ahmed *et al*., 2011).

Nutritional composition databases provide detailed information on the nutritional content of important components in various food items. They have a wide variety of uses including (Church, 2006):

- Formulation of appropriate institutional and therapeutic diets including those for schools and hospitals

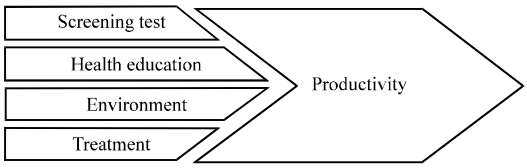

Fig. 1: Health care provider program

- Identification of needs in the education and promotion of healthy dietary habits
- Epidemiological research on relationships between dietary habits and diseases
- Observation of nutritional values, safety and authenticity of foods for food trade and consumer protection and information

The current program designed by the health care provider that partners with the consumer electronics manufacturer has attempted to increase the company's productivity through the inclusion of the following into the program (Fig. 1):

- Screening test: routine medical check-up for employees
- Health education: information and education for employees to be aware of unhealthy dietary habits that often occur at the workplace and solutions to these habits
- Work condition: information for employees on how to maintain a safe work environment
- Treatment: investigation of any work-related incidents that would require medical attention and assurance that the proper medical attention is given without affecting the corporate insurance program

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Nutrition monitoring systems should be evaluated periodically to ensure that their objectives are met then updated accordingly, especially towards food policy interventions (Suresh, 2005). Wipfli and Lovis (2010) propose that an alert system can be viewed as an interaction between the users and the system. Normal intake level is defined as the long-term average intake of a food or nutrient. The concept of long-term average daily intake or usual intake is important because dietary recommendations are intended to be met over a certain time period. Consequently, the normal intake is often the focus for researchers in examining relationships between diet and health (Coulston *et al*., 2013).

The essential components of disease management based on nutrition and diet are (Norris *et al*., 2002):

- Identification of population with specific characteristics
- Guidelines or performance standards for care
- Management of the identified populations
- Information systems for population behavior observations

PROBLEM FORMULATION

Following a survey on the current condition of the consumer electronics manufacturer, the health care partner provides the workers with a low-salt diet program as a part of its disease management program. The participants in the program consist of only employees suffering from diseases like hypertension, diabetes and tuberculosis; the employees who are not a part of the disease management program are free to choose their own meals. The existing system resulted in a low level of health improvement with the hypothesis that the monitoring method is the least effective part of the program. There is currently no smart card registration system to monitor the activities of the workers at the factory's cafeteria. Additionally, the method of observation only involves the production of a monthly report for those who failed to follow the low-salt diet program.

Based on this problem, the research query was formulated as "How to improve the design of a nutrition management and diet monitoring information system specifically for the workers of a consumer electronics manufacturer?"

METHODOLOGY

The details of activities for the research are as follows (Fig. 2):

- Survey: data were obtained from the consumer electronics companies as well as the health care providers or occupational health services companies
- Current condition: researchers were informed of the existing condition of the nutrition management systems based on data obtained from the surveys
- Research question: the overall query was formulated from problem formulation
- Literature research: through literature, the researchers learned about the standard model of nutrition management and diet monitoring information system that has been implemented in the industry
- Analysis and design: the result of literature research was combined in line with the existing system

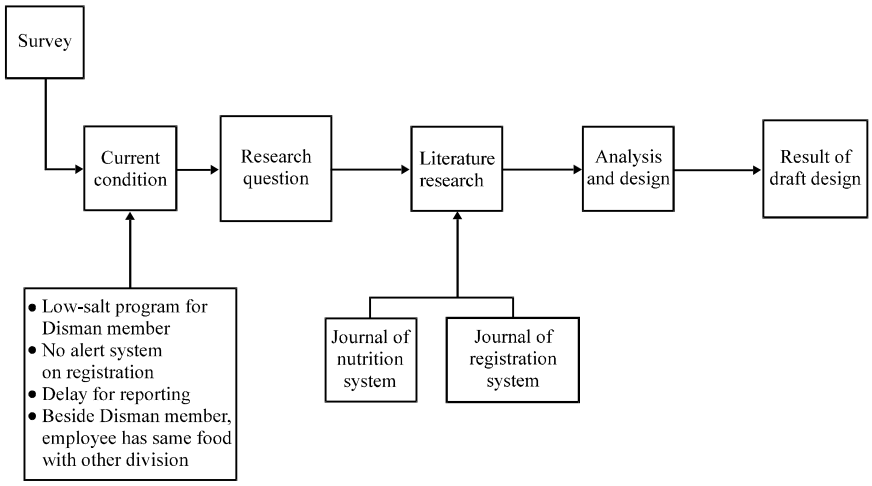

Fig. 2: Methodology

- Result of design: an information technology model was produced to be used as the improved version of the Nutrition Management and Diet Monitoring System

REQUIREMENTS INFORMATION

Kim *et al.* (2009) has detailed some of the information required to design the user interface of a nutrition management module which is used as the standard reference to design the nutrition management and diet monitoring information system in this study. Figure 3 depicts the module's description.

The nutritional information presented by Heinonen *et al.* (2009), Kashima *et al.* (2008), Lee *et al.* (2009), Snae and Brueckner (2009) and Youbo (2009) were also used as references. Moreover, Snae and Brueckner (2009) and Youbo (2009) also discussed several supplemental information such as the sex, age, height and weight of the population of interest. However, Altmatsier has recalibrated the dietary requirements for application in Indonesia. The requirements include:

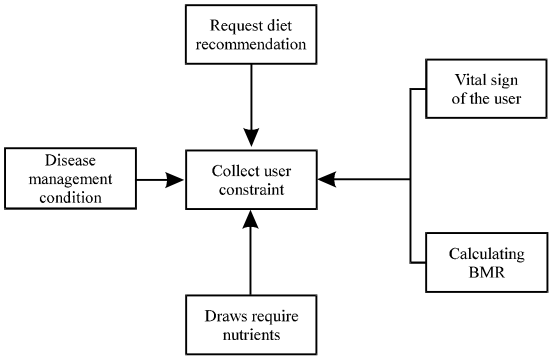

Fig. 3: Nutrition extraction module (Kim *et al.*, 2009)

- Personal data, including sex, age, height, weight, Body Mass Index (BMI), Basal Metabolic Rate (BMR) and activity
- Nutritional data, including energy (kcal), protein (g), carbohydrate (g), lipid or fat (g), calcium (g), iron (mg), vitamin A (in Retinol Equivalent/RE), thiamine or vitamin B1 (mg) and vitamin C (mg)

RESULTS

Figure 4 presents the workflow design proposed after combining a variety of important standards for a nutrition module. The boxes with thick lines are modules that were added to the newly proposed workflow of the Nutrition Management and Diet Monitoring Information System which include:

Offline module: The application of an expert system to calculate nutritional content based on the tailored needs

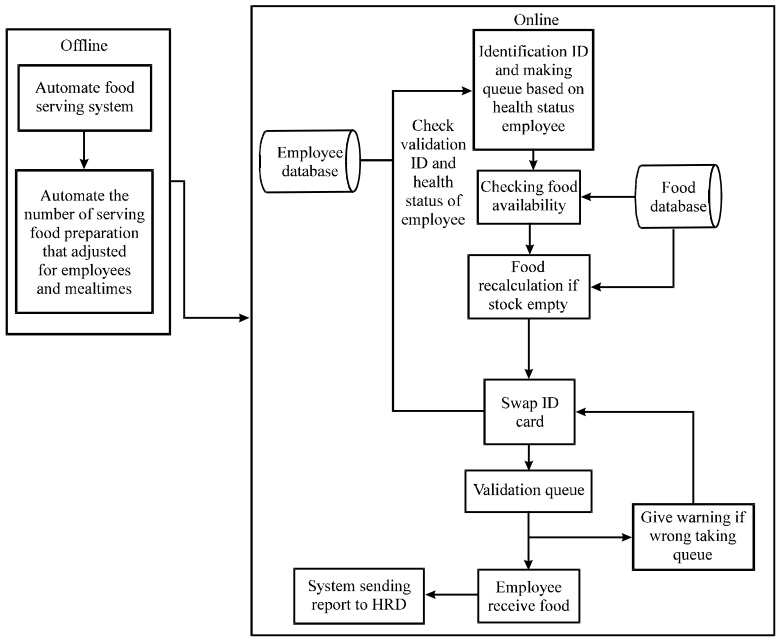

Fig. 4: Proposed workflow

of each worker. It is used for the automation of food preparation and portion distribution according to the number of workers and meals.

Online module: The application of a cafeteria registration control system through the use of contactless smart cards. It is used to identify each worker based on his/her health status and the corresponding type of meal or diet that said worker could have for the day. Figure 5 illustrates the workflow for the Nutrition Management and Diet Monitoring Information System. This system's first step is to create a plan for the main components, namely:

- The workflow diagram expert system
- Table reference design-based rules as well as knowledge representation method
- Planning database
- Planning user interface and state chart of the user interface

Some conclusions generated by the system included the AMB (basal metabolic rate), physical activity level, the BMI (Body Mass Index), nutritional composition and dietary intake composition. Figure 6 shows a workflow diagram for the expert system. The expert database along with the nutrition database, was used to create a reference table that served as the basis upon which decisions were made on the food types suitable for each worker.

IF-THEN rules is a method that facilitates the consideration of every possible variable or condition that could influence a decision-making process. As the name implies, IF-THEN rules are divided into two main parts: condition (the IF statement) and execution (the THEN statement).

The former part is a requirement that must be met while the latter is an executed action to fulfill the condition; this method is also known as forward-chaining. An example of the rule-based design for the expert system is as follows:

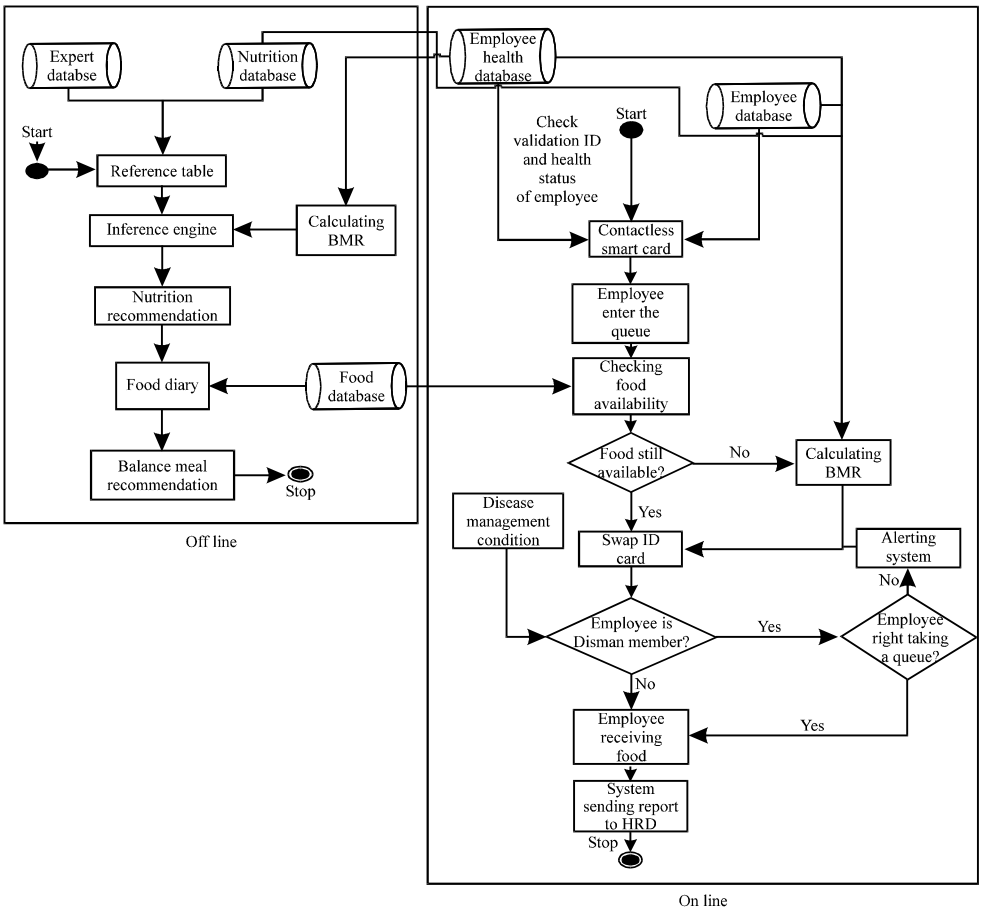

Fig. 5: Design workflow system

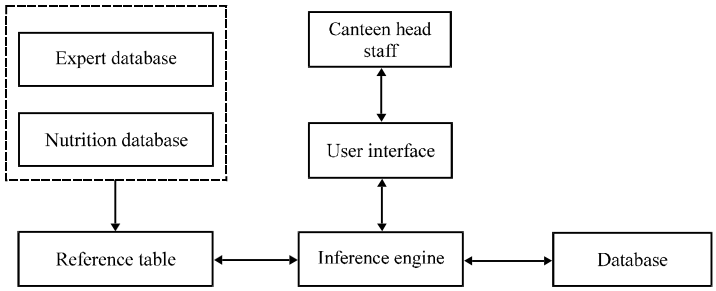

Fig. 6: Expert system workflow diagram for management nutrition

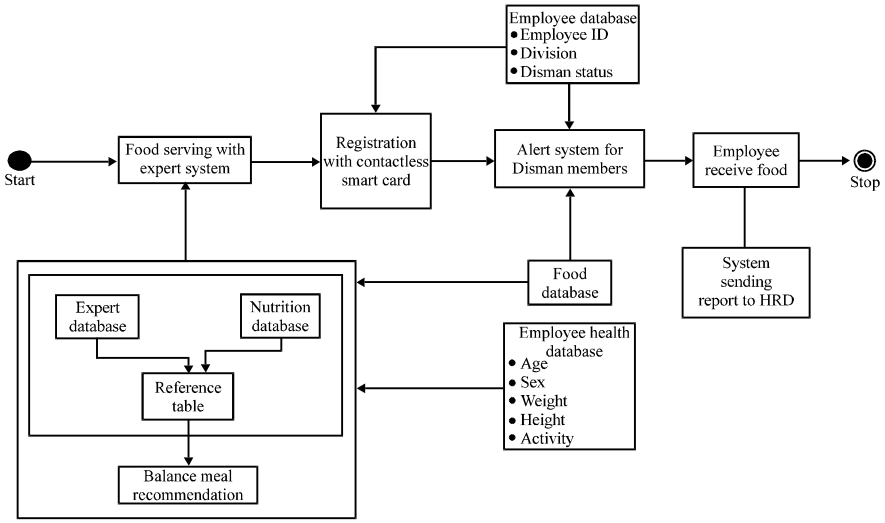

Fig. 7: Registration control system workflow

IF resultIMT = Normal
THEN Energy Amount = ResultAMB×CAf
ELSE IF resultBMI = Skinny
THEN Energy Amount = (resultBMR×resultActivity)+500
ELSE Energy Amount = (resultBMR×resultActivity)-500
Energy AmountPerServe = Energy Amount/3
CarbohydrateAmount = ((65×Energy Amount PerServe) /100)/4
ProteinAmount = ((15×EnergyAmountPerServe)/100)/4
LipidAmount = ((20×EnergyAmountPerServe)/100)/9

Figure 7 illustrates a workflow for the registration control system. The employee database is used during registration and validation through issuing the worker with their own contactless smart card IDs. The process would start with the worker ID card validation that would then determine the appropriate cafeteria counter for said worker. In this case, the counter is divided into two types: the diet monitored counter and the regular counter. The division of the counters would be tailored according to the health status of the workers. To allow for meal distribution, the workers must comply with the validation system's counter assignment. If the validation fails, the worker would be given an alert or warning and would have to return to the appropriate counter. The system then creates a report for the Human Resources Department.

CONCLUSION

This study analyzed the existing workflow as well as the best practices and standards in the Nutrition Management Information System. A model was then created with the purpose of optimizing and improving the existing Nutrition Management and Diet Monitoring Information System at a consumer electronics manufacturer. The use of contactless smart cards for the registration and authentication processes could potentially reduce the possibility of human errors as well as improve the time required to implement the system. In terms of the automation process and calculation, the implementation of expert systems would allow for the overall system to formulate a decision in a more accurate, precise and timely manner.

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