Goal-Seeking Framework for Empowering Personalized Wellness Management
Mukesh K. Chippa and Shivakumar Sastry
Electrical and Computer Engineering, University of Akron

Abstract
We present a goal-seeking framework for decision-support to empower personal wellness management (PWM). PWM is a complex issue that lies at the intersection of multiple disciplines including psychology, exercise science, medicine, behavioral management, nutrition, and emerging technologies. The framework enables us to integrate knowledge from these disciplines, interact with participants, recommend specific exercise and nutrition actions to the participants, and monitor their performance toward their objectives for wellness. The objective for the PWM is to empower participants to manage and sustain their own wellness.

Introduction
• PWM addresses a critical national priority that has the potential to significantly reduce health-care costs. Approximately 75% of the health-care costs are associated with management of chronic illness such as Diabetes and Hypertension.
• Urgent need to fundamentally transform medical practice from the current reactive approach to a pro-active, wellness-centered, approach; i.e., keep healthy people healthy for longer times.
• This project aims to design, implement, and validate a decision-support system that will empower PWM.

Goal-seeking Paradigm
• The decision-support system selects one or more Alternative Actions for a participant (individual or group) based on anticipated consequences of the action(s) consistent with the MEANS of the participants.
• Uncertainties may affect the actual consequences. The evaluation function determines whether or not the actual consequences are within an acceptable tolerance w.r.t. the anticipated consequences.
• Tolerance is participant-specific and may vary over time.
• Participant disposition and needs is established with a PWM-Motivation Inventory Questionnaire.
• When the decision-support system cannot identify a suitable action, it will escalate the selection of action to a human. The reasons are tracked using a Behavioral Analysis Questionnaire.

Design Tasks
• Alternative actions, Consequences, Uncertainties, and Tolerance determined through cross-disciplinary discussions involving – Sports/Exercise Science, Nutrition, Medical professionals and Technologists.
• Reflection Mapper
  • Using well-established model for Human Weight Dynamics (Kevin Hall, NIH) from the literature.
  • Following Navarro-Barreintos idea, we are investigating front ends that can provide Physical Activity Level and Calories Input to the Kevin Hall Model.
  • Exploring MEANS and Dimensions of Wellness alternatives for Year 3 Pilot on Obesity.
• Evaluation Mapper
  • Designing a Kinect-based System for correcting/guiding participants to improve self-efficacy and, hence, adherence (H. Pidaparthi, M.S. EE, Dec 2014).
  • Received Design and BOM from Rockwell-Automation Advanced Technology group to instrument an exercise bike and assess participant performance in a controlled setting. (A. Mahmadi, M.S. EE, Dec 2014).

Current Challenges & Issues
• Assure sustainable lifestyle change of participants while accounting for individual variability and collective similarity.
• Automated flow processing infrastructure that can dynamically update the models and the wellness ontology.
• Is it useful to model the complex interactions between the macro-nutrients in food and weight dynamics, or the effects of dominant hormones and cytokines that affect weight?

Dimensions of Wellness
• Exercise/Nutrition Intensity
• Physical Activity
• Calories Intake
• Social Impact
• Weight
• Energy

Parameters
• Hall Model
• Human Weight Dynamics

Current Status
• PWM-MIQ Draft Complete. The paper instrument was administered to sports-science students and community based participants. Based on the feedback, we determined it was better to design a software system to reduce the burden of user interaction.
• Completed implementation of the goal-seeking decision-support system for charge-discharge scenarios of battery management systems.
• Replaced models for Lilon Batteries with Kevin Hall model for the Reflection Mapper. Also added front-end based on Navarro-Barreintos model derived from the Theory of Planned Behavior.
• Explored methods to integrate hormonal dynamics with the Kevin Hall model. Found that the time scale at which the model parameters are calibrated is an issue. Need to explore alternative approaches and value of this level of modeling.

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