

E-Coaching for Health



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E-coaching is an emerging computing area in which intelligent systems are used to encourage progress toward specific health-related goals by providing tailored training and guidance. Progress in this field could well be a key enabler of increasing health span and well-being for our increasingly care-demanding society.



Over the past few decades, our society has experienced radical changes incomparable with any other time in human history. This information technology revolution continues to transform the way in which we perceive and interact with the world, including how we work, entertain, and relate to one another.

Although there have been many positive developments, major negative consequences of the widespread use of computing technology are that people are less physically active, isolate themselves more, tend to have increased levels of stress, and their diet is less nutritious. These lifestyle changes are already viewed as a global epidemiological threat, compromising healthy longevity not only for citizens of developed countries but also those living in developing nations, where obesity and diabetes are becoming the new malaria and HIV. It is therefore imperative for us to find effective new means for raising public awareness and changing behavior in order to improve our ability to remain active, healthy, and resilient. One area that offers this potential is e-coaching. E-coaching, which is the use of computing technology to help shift an individual's behavior to improve well-being, promises to play a leading role in helping us realize a healthier and more mindful society.

Changing behavior is far from straightforward. Over the years, a multitude of theoretical frameworks have been explored to help explain the reasons why humans break or follow established patterns of action. Examples of these are the Social Cognitive Theory, Goal-Setting Theory, or the Transtheoretical Model, all of which offer a degree of potential in influencing the individual to adopt new habits, set attainable goals, or positively manage expectations. Nevertheless, transforming these theories into practice is difficult, especially in an era in which human attention span and ability to be self-reflective are diminished. Few of us are self-aware enough to recognize the subtle ways in which we can positively and negatively affect our situation, nor do we possess enough self-determination to take action. This in turn means that a vast majority of us need help.

Really, we must accept that changing behavior to improve our health is a lifelong and resource-demanding activity. Most of us need to be frequently, if not continuously, observed, listened to, questioned, understood, reasoned with, taught, and/or advised—that is, coached—in several aspects of our lifestyle. Although it is fair to say that we encounter (human) coaches every day, including physical therapists, friends, clinicians, and so on, they are

often only present at infrequent and often random moments. Most individuals would benefit from opportunistic coaching—to occur at the time and place when it is needed—instead of when possible.

Recent advancements in ubiquitous computing, artificial intelligence, and human-computer interaction have made it possible to develop the first generation of autonomous coaching systems, which are expected to deal with the inherently complex nature of coaching humans. As intelligent systems, e-coaches exhibit abilities similar to those of their human counterparts: sensing (observing, listening, questioning), learning (acquiring knowledge, understanding), and actuating (reasoning, clarifying, advising). An e-coach can observe, reason about, learn from, and predict a user's behavior to provide tailored and effective guidance to reach an individual's goal.

Sensing options are currently unparalleled due to the number of smart, ubiquitous sensing systems developed and deployed on a global scale. Instrumented devices such as smartphones or wearables—ingrained throughout our daily activities—enable unobtrusive observation and detection of a wide variety of behaviors as we go about our physical and virtual interactions with the world.



These observational capabilities are largely augmented by the widespread adoption of the Internet of Things; these new sensing ecosystems mean nothing we do goes unnoticed.

The vast amount of data generated by such sensing infrastructures can be digested by powerful machine-learning and data-mining algorithms, which map the raw data (for example, our GPS coordinates at specific times) into predictive trajectories of behavior (for example, when you walk out of your apartment in the morning, your smartphone displays the next departing train to your usual destination and approximate time to walk to the station). The processed data is combined with computerized behavior-change frameworks and domain knowledge to dynamically generate tailored recommendations and guidelines through advanced reasoning. Acting upon the user's detected situation and goals requires a system that contains the proper content and applications that can build collaborative relationships and fluent communication channels between e-coaches and the user. This can, for example, be realized through soft embodiments, such as virtual or augmented reality, or hard embodiments, such as robots or other interfaces.

E-coaching comes with some important challenges and dilemmas still to be addressed. Privacy, respect for autonomy, sufficient expertise, and policies and laws that support both integrity and responsibility of such systems are among the most relevant. For example, e-coaches should not eradicate a user's ability to make decisions. They should encourage changes to user behavior in accordance with that individual's own stated goals or vision for his or her lifestyle. Likewise,

users should remain capable of assessing whether an e-coach's suggestions are consistent with their own values and priorities in life. A myriad of sometimes sensitive data is normally necessary for e-coaches to fully understand a user's situation and context to provide tailored recommendations, thus proper data management, anonymization, and encryption are essential to stave off any potential personal threat.

E-coaching is still in its infancy. The enormous technical, ethical, and societal challenges will require significant effort in order for these tools to be deployed successfully and to their full potential. Nevertheless, given our health and clinical care challenges, now is the time to push for these effective new technologies to both improve our lives and extend our health span. Shall we give it a try?

IN THIS ISSUE

We received a wide range of impressive articles to our open call for papers. So many that we will be publishing a second issue on this topic later in 2018.

In this issue, we present four articles addressing relevant theoretical and practical aspects of e-coaching systems for health and well-being applications.

In "Architecting E-Coaching Systems: A First Step for Dealing with Their Intrinsic Design Complexity," Sergio F. Ochoa and Francisco J. Gutierrez propose a new theoretical framework to assist in the design of an e-coaching system. The authors decouple the structural elements of the system from the coaching strategies to facilitate the scalability and adaptability to new domains or unforeseen aspects in the design phase. This framework could also help to prototype e-coaching

systems more rapidly and also guide the design of the digital coaches as a collaborative activity in which software engineers, domain specialists and end users participate in the co-creation of the system.

In "Emotion and Motivation in Cognitive Assistive Technologies for Dementia," Julie M. Robillard and Jesse Hoey discuss seminal advancements in the integration of emotions in computing, including their use in building e-coaching technologies that are more effective and acceptable to the user. The authors analyze the limited success that assistive technologies have had in practice so far and link this to a lack of social and emotional alignment. Through the Bayesian Affective Control Theory, the authors introduce a quantitative socio-psychological framework that integrates salient sources of information such as prior expectations and observed emotions and actions to model emotional behavior in computerized assistive systems. This framework helps provide the grounds for moving beyond current emotion-appraisal-based e-coaching systems and toward systems more aligned with the values and needs of users.

In "Recommender System Lets Coaches Identify and Help Athletes Who Begin Losing Motivation," Paolo Pilloni, Luca Piras, Salvatore Carta, Gianni Fenu, Fabrizio Mulas, and Ludovico Boratto describe a method for automatically anticipating if and when an athlete will stop training due to a decline in motivation. The authors present a dropout-predictive model developed on the historical workout data collected from users' smartphone sensors and self-reports. Once a risk of



dropout is detected, the system notifies the personal coach with a report on the exercise statistics and possible recommendations. Coaches can then communicate with these individuals through a web-based interface to encourage these individuals to keep training through more personalized routines and effective strategies to discourage training abandonment.

In “Monitoring Eating Behaviors for a Nutritionist E-Assistant Using Crowdsourcing,” Mario O. Parra, Jesus Favela, Luis A. Castro, and Arturo Morales present an approach designed to automatically infer and counsel people regarding eating behaviors, a fairly uncharted and challenging area in the e-coaching domain. The authors combine semi-autonomous crowdsourced food intake assessment with a virtual conversational assistant to monitor and coach individuals undergoing treatment for weight reduction. Users are asked to regularly photograph their meals, which are then evaluated for nutritional content, calories, and wholesomeness by a group of Internet users. This information is used to inform the digital assistant about the user’s diet so that he or she can then respond with tailored recommendations and motivational tactics. The authors report on the latency, cognitive load, and accuracy of various crowdsourced food-intake assessment methods and also provide some preliminary findings on users’ perceptions of the nutritionist e-assistant.

These four articles provide an exceptional overview on the innovative work taking place in the e-coaching area. Being chiefly multidisciplinary by definition, e-coaching will continue to

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revolutionize the way we interact and communicate with the world, augmenting our self-awareness and ultimately yielding an unparalleled ecosystem to support our future health and wellness. 

