Integrated Human Behavior Modeling

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Abstract. In order to prevent emergencies or critical situations where humans are the origin, a timely provision of information thus obtained for the coordinating services and the on-site staff (e.g., emergency dispatch centers, emergency physicians, police) is necessary. The detection of critical situations and the early alarming, e.g., in case of deterioration of the person's health status or a critical incident in a public space like a stadium, could prevent acute emergency cases and the resulting negative impact on individual persons and the environment. To analyze the current situation, the human behavior must be understood, analyzed and modeled on the basis of, e.g., monitored activities, user mobility, and selected biological parameters. Only an integrated and comprehensive human behavior model can be the basis for the prevention of emergency cases.

Integrated Human Behavior Model: Motivation and Components

Understanding human behavior is a key issue for building intelligent environments, which are targeted to support their inhabitants in the fulfillment of their daily tasks and intentions, but also to pro-actively prevent undesired situations and to recognize alarming deviations from normal behavior. Applications for future intelligent environments range from monitoring and adaptive support for single persons to the analysis and anticipation of behavior in groups or large crowds. Possible application fields are user adaptive, intelligent homes serving the individual comfort or "smart workplaces" improving productivity and optimizing processes.

Applications in the medical domain can support the individual care and monitoring of patients in hospitals, rehabilitation centers or at home. For the surveillance of public spaces, group dynamic processes – affected by individual behavior – can be modeled for the recognition of anomalies in large groups or for supporting guidance in evacuation situations. In the control of traffic systems and intelligent transportation systems, individualized guidance and flow control can take the preferences and current situation of the driver into account as well as possible influencing factors from surrounding traffic.

Dagstuhl Seminar Proceedings 07462
Assisted Living Systems - Models, Architectures and Engineering Approaches
http://drops.dagstuhl.de/opus/volltexte/2008/1457

In these future human-centered applications, the human user and his behavior must be understood and represented within the system as a whole. The modeling of the user as a virtual, bio-psycho-social entity can be based on the different qualities that define the overall functional health status, such as the physical health functioning (e.g., vital parameters such as pulse rate, blood pressure, respiratory rate or skin humidity), mental health functioning (e.g., stress, activity, basic emotional affections, cognition, orientation), psychosocial functioning (e.g., social contacts, communication), and the activities of daily living (ADL) (see Figure 1). All parameters are related to each other and show various interdependencies, many of which remain unknown so far. The recognition of activities and behavioral patterns can give knowledge on the physical and mental condition of a person and may allow new preventive approaches by very early and sensitive detection of those changes [Ce04] [Gl06]. Furthermore, possible intentions or plans can be inferred from user's current actions.

On the level of social interaction, these applications account on individual personal characteristics such as capabilities, abilities, knowledge, expertise, educational standard and interests. Knowledge about interaction schemes in groups supports the collaboration and interaction of individuals and helps to derive possible further planned actions of single persons.

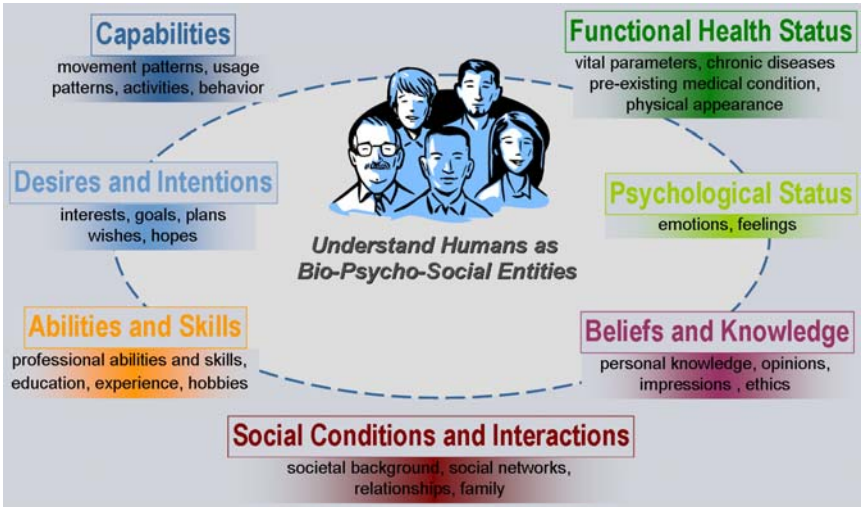

Fig. 1. Possible Components of a Human Behavior Model

User centered applications must be based on a multi-layered technology stack: wearable and environmental sensors as well as user profiles and interaction profiles with technical devices are building the highly heterogeneous and highly distributed sources of the information basis. Technological challenges lie in the integration and fusion of this heterogeneous information in a common model. Information on different levels of semantic abstraction must be aggregated and fused, always considering varying data quality. Adequate modeling schemes must be found to represent complex interdependences in an explicit and comprehensible way. A special

interest must lie in data security and ethical aspects in the survey and analysis of personal and private information.

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