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Article / Book Information

Title	Sensor-based estimation of psychological states
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/	, , , pp. 455-458
Journal/Book name	Proceedings of the IADIS International Conference Interfaces and Human Computer Interaction 2011, , , pp. 455-458
/Issue date	2011, 7

SENSOR-BASED ESTIMATION OF PSYCHOLOGICAL STATES

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ABSTRACT

The purpose of this paper is to draw attention to the importance of sensory technology for the purpose of estimation of psychological states such as affect, personality, and mental health. Firstly this paper summarizes conventional methods used to measure psychological states, and describes related known issues. Furthermore, referring to recent studies that tried to incorporate sensory technology to estimate psychological states, it discusses the advantages and disadvantages of sensor-based estimation methods, in comparison with conventional ones.

KEYWORDS

Psychological states estimation, sensory technology, human behavior, affect, personality, mental health

1. INTRODUCTION

Techniques that attempt to classify and measures psychological states require acknowledgement of its dynamic behavior, and therefore it is still necessary to propose less obtrusive methods which achieve results of greater accuracy. Although both experimental and non-experimental methods have been extensively used in the process of measuring behavior in the last century, these methods are generally invasive, and require huge amount of time and resources for its operation. Despite the countless number of characteristics defining the human being, this paper focused on three behavior-based psychological states, namely, affect, personality, and mental health.

On the other hand, there are a variety of possibilities which utilize sensors for the recognition of psychological states. Occupancy, movement and orientation, touch, position, identity, affect, and others, are contexts where recognition mechanisms such as walking gait patterns, trunk movement, gesture analysis and others utilize sensors in different ways. Although a number of issues have been found in the utilization of sensory technology for psychological states estimation (Wilson, 2008), its adequate utilization has facilitated the measurement of such states providing unobtrusive and time-efficient mechanisms to estimate psychological states through the measurement of a selected set of body movements and behaviors.

The purpose of this paper was to draw attention to the importance of the incorporation of sensory technology in the estimation of psychological states by outlining limitations, concerns, advantages and disadvantages of methodologies in recent studies.

2. CONVENTIONAL ESTIMATION METHODS

2.1 Affect Estimation

There are several affect measuring techniques, where the brain is perhaps the most fundamental source of emotion (Brave & Nass, 2008). Another mechanisms used for the study of emotion is the measurement of the autonomic nervous system, the use of facial expression, voice, and body movements. Picard (1997) referred to the complexity related to the physical aspects of the estimation of human behavior, arguing that emotion does not map to a fixed form of physical communicating means. In general, emotion and other psychological

states are not always displayed in consistent ways, which complicates the process of behavior recognition. Some of the complicating factors are the intensity of the emotion; the type of emotion which may emphasize on an specific characteristic of a given emotion; the way the state was induced; and the social display rules by which a person express or suppress emotion (Picard, 1997).

Also, the characteristics of the scenarios inside and outside the laboratory settings pose different challenges. Most of the behavior-related studies have been confined to artificial lab scenarios with important limitations (Picard, 1997). Many emotion recognition experiments done in laboratory settings resort to subjects whose emotions intensity is strengthened or controlled, and therefore can be repeated at convenience of the research goal. Subjects in laboratory settings might exhibit a much smaller repertoire of emotions compared to those they would express in their natural world; or they might express emotions they think they should express, instead of letting them arise naturally. These issues were defined as input-specific, namely, display rules, deception, and systematic ambiguity (Fragopanagos & Taylor, 2005).

The ideal study should be conducted by means of real-life observation, which many theorists have deemed impossible (Wallbot & Sherer, 1989). Picard (1997) added that wearable computers offer the possibility of collecting data from people as they engage in natural and social interactions. However, it is of critical importance to note that wearable devices should avoid annoying or invading their privacy. One mechanism analyzed to prevent this kind of implications is to avoid computers from storing information, and rather resort to real-time affective analysis, which is an area of current research (Foner, 1996; Picard, 1997). Wearable devices may as well bring undesired situations, and therefore it is necessary for users to be made aware of both the benefits and disadvantages of these technologies.

2.2 Personality and Mental Health Estimation

Self report inventories, which have been also called objective tests (Meyer & Kurtz, 2006), have been firmly established as the preferred personality (Winter & Barenbaum, 1999), and mental health measuring methods. However, specific issues regarding these methods have been pointed out. Meehl (1945) contends that structured personality tests lack of a restriction-free nature, which can not accurately describe the examinee behavior. This would falsify the actual relationship between what a man says and what he is. This adds to arguments relating limitations in self-knowledge or self-perception, and personal dynamics.

Empirical evidence suggests that an individual's behavior is not constant from situation to situation. Mischel (1973) argued that there is evidence supporting substantial changes in practically all of the dispositional measures of personality of characteristics of individuals over time and across situations.

Also John and Srivastava (1999) argued that the number of scales designed to measure personality has escalated without an end in sight. While researchers have experienced little guidance and a lack of an overall rationale, it is noted that a systematic accumulation of findings is necessary in order to cope with the difficulty related to the bewildering number of concepts and scales. This is aggravated by the fact that often scales under the same name measure concepts representing different meanings (John & Srivastava, 1999).

Likewise, a variety of approaches like interviews, questionnaires, behavioral observation, and case studies (Robson, 1993) have been utilized in the process of mental health gathering information. However, within working and organization settings, occupational psychologists are often limited to observing natural variation, and therefore experimentation is difficult (Chmiel, 1998). As a consequence, in line with the accepted measuring techniques for personality, mental health studies have had preference for questionnaire-type approaches as a widely accepted measuring technique. However, as previously noted, issues regarding the use of self report inventories have been widely acknowledged.

3. SENSOR-BASED ESTIMATION METHODS

3.1 Affect Estimation Method

In a recent study, Eguez Guevara and Umemuro (2010) utilized movement and infrared sensors to assess affect through movement descriptors such as walking speed, motion load, walking directness, and arms' movements. The subjects of the study performed daily activities in no-laboratory settings. In this method no devices were attached to subjects, and no emotion was induced. Behavior was assessed in terms of speed,

frequency and variability of human sensory data. This method was suited only for individual experimentation as subjects' identification was not available. Affect was estimated at a semi-real time basis where the margin to report the estimation was about a half to few hours.

3.2 Personality and Mental Health Estimation

In the method proposed by Eguez Guevara et al. (2011), sensory raw data were used to assess personality and mental health of subjects performing daily office routine. Acceleration and voice intensity data were captured by Business Microscope (Yano & Kuriyama, 2007) device which was worn by subjects as a name-tag. Sensory data corresponding to walking, talking, desk working, and idle behavior categories were analyzed in terms of variance, amplitude, or frequency and mapped to each listed behavior. It was then conducted a correlation analysis between the participants estimated behavior and their personality and mental health questionnaires scores.

3.3 Discussion

Both methods described in sections 3.1 and 3.2 surpass the invasive nature of conventional affect and personality and mental health measuring techniques which limits the normal activities and behavior of subjects being tested. Subjects of these methods contrast to conventional ones in that they need not to attend any laboratory setting, as the experimentation is done in their own living or working place. This prevents subjects from laboratories potential stress and distraction. Also, contrary to conventional techniques, the proposed in this section did not use any kind of made-up behavior or emotion. No induced-stimuli is beneficial as it has been argued that it is one reason for poor results in related studies for only weak, and context-lacking stimuli is generated.

Since the affect estimation method proposed in section 3.1 lacks of a subject identification system its experimentation in multi-subjects layouts is unfeasible. However, the time-to-output of both methods described in section 3.1 and 3.2 surpass the huge amount of time and resources needed by conventional estimation techniques. Furthermore, as these methodologies are set by continuously loading data, the estimated psychological states will always provide up-to-date information.

3.3.1 Application

The use of sensory mechanisms in the measurement of psychological states brings broader opportunities to understand humans, and the relation between their behavior and psychological states.

For example, the availability of such information may help families' members to take proper actions in light of others' affect in order to enhance the individual capacity to provide affective support to other family members. For instance, a given family member a, who lives away from his/her family, might feel ease when he/she knows other family members appear with neutral or happy state. However, family member a may pay closer attention to his family condition, if other family members are found to be sad, or going through hard times. In this case, family member a's awareness was achieved through the availability of the family members' psychological states and its adequate transmission.

From a different viewpoint, psychological states' information will also be informative to various research fields, for example to the study of the Affective Computing. Affective Computing, seeks to provide to any computer form the ability to recognize, express, regulate, and utilize emotions to respond to human emotion. Since personality, as any other human psychological state, is characteristic of human beings, the process of designing computers or robots which resemble to the human being should consider personality as an important aspect to characterize. The possibility of designing robots able to engender personality-based behavior opens discussions relating the advantages or disadvantages of the incorporation of these specific human characteristics.

4. CONCLUSION

The shift from explicit means of human input to more implicit forms of input enables more natural interactions with the physical environments, which provide sufficient input and information without demanding major burden to users. With the help of sensory technology, and without using physically demanding devices, or psychologically demanding monitoring techniques, it was suggested methodologies for the estimation of psychological states based on external signal like body movements and human behavior.

This paper opens a discussion for application possibilities that can make use of psychological states' information for the service and better understanding of human beings in non-critical environments. The accessibility to information of psychological states is of great interest to the development of services that ultimately are designed to serve people in more humane ways.

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