

Adjustment of Medical Observations Influenced by Emotional State

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ABSTRACT

Research in neurophysiology and neuropsychology have established a strong dependence between emotion, subjectivity and decision-making. Otherwise, medical observations are used as one of the main inputs of clinical decision support systems (CDSS) which are designed to support patients with chronic progressive diseases. However, these observations are influenced when confronted with a critical emotional state and they are likely to be subjective. To generate efficient results, CDSS must bring these subjective observations closer to the reality by using data describing the observer's emotional state. To solve this issue, the authors of this article propose to identify the dependency relationship between observations and emotions. Then they provide a solution that moderates the patient and caregivers' observations within a medical decision support system, so that it can generate efficient results. Finally, they propose two fuzzy systems to adjust the influence of emotional state on medical observation. These two systems make the medical observation closer to the current condition of the patient.

KEYWORDS

Emotional Influence, Emotion Recognition, Estimation, Fuzzy System, Medical Observation Adjustment

INTRODUCTION

Emotions and affect are researched in various scientific disciplines such as psychology, physiology and computer science (Sariyanidi et al., 2015). Many clinical and biomedical studies have been using the dimensional representation and prediction of emotions (Gunes et al., 2011). These indicate that affective computing has matured enough to have a presence and measurable impact in our health lives.

Otherwise, computer qualities (memory, speed, computational power) emerged as a potential resource for solutions to medical difficulties like those presented in (Chatterjee et al., 2017a; Chatterjee et al., 2017b; Chakraborty et al., 2017). On the other hand, several computerized systems of medical decision-support have been developed (Séroussi & Bouaud, 2014). These systems use the characteristics of individual patients and match them with a computerized knowledge base in order to generate patient-specific information in the form of recommendations (Haynes & Wilczynski, 2010). The patient's characteristics can be either test values or medical observations. A medical observation is useful for a diagnosis construction, patient's support elaboration and information transmission. In the case of progressive chronic condition, the patient or his entourage (i.e., family members, caregivers) can write a medical observation, since he/she lives in domestic conditions (Gaugler et al., 2008) and is cared for primarily by his family members. These observations will be used in Clinical

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Decision Support Systems (CDSS) as one of the main inputs. Based on these observations, CDSS will reason and give medical recommendations. Consequently, it is very imperative to verify and evaluate the proximity of these observations to the reality. Indeed, caring for a loved one, particularly a parent, a spouse, or a child, is especially difficult as he/she is faced with the decline of the person's cognitive and physical capabilities. According to Bagnara et al. (2010) "the health care domain is one of the most emotional contexts where human factors can be applied". Due to the long hours that health care providers often spend with the patient, the observations could be strongly influenced by emotions (Killgore et al., 2006). Therefore, emotions can influence the patient and caregivers' observations. These observations are usually subjective data, which may cause an over-estimation or under-estimation of the patients' symptom severity (i.e., observation). This issue of estimation requires further improvement of the CDSS, because it may influence the decisions about treating patients' symptoms.

In the literature, several recent works emphasized the determination of emotions from physiological signals. Since a comprehensive overview of the recent developments in the field is outside the scope of this paper, we have limited ourselves to three highlights in order to illustrate the current state-of-the-art. The authors of (Malkawi & Murad, 2013) used fuzzy sets to represent emotions, and fuzzy rules to represent mappings from fourteen measurable human factors to twenty-two different emotions. The authors of (Quesada-Tabares et al., 2017) used a device called Neurosky Maindwave device, which has a single electrode to acquire the EEG signal. They also used Matlab software and a modeler software called IBM SPSS, which process and classify the signals respectively. The authors of (Zhuang et al., 2017) introduced a method for feature extraction and emotion recognition based on empirical mode decomposition. These works used psychophysiological signals to determine the emotional state of the person. However, to the best of our knowledge, there is no work that has dealt with the adjustment of subjective medical observations. Therefore, in this paper, emotions are modeled so that subjective observations can be identified. Once identified, subjective observations must be adjusted to become closer to the reality. Then, two fuzzy systems are proposed, the first for the identification and the second for the adjustment.

This paper is structured as follows: in the next section, a background, which presents emotion and fuzzy logic fundamentals, is provided. Then, we describe several works that deal with the determination of "valence" and "arousal" dimensions from physiological signals. The contributions and some results are shown in the following section. Finally, conclusion is put forward in the final section.

BACKGROUND

Emotion Representation

Kleinginna (1981) defines emotions as "a complex set of interactions between subjective and objective factors, mediated by neural/hormonal systems, which can give rise to affective experiences, such as feeling of arousal, pleasure/displeasure; generate cognitive processes, such as emotionally relevant perceptual effects, appraisals, labelling processes; activate widespread physiological adjustments to the arousing conditions; and lead to behaviour that is often, but not always, expressive, goal-directed, and adaptive".

Representing emotions is proposing a formalism consistent with the existing psychological results, while allowing a simple manipulation of emotions. In this context, the authors of Scherer (2000), Fontaine et al. (2007) and Grandjean et al. (2008) proposed a description of three major emotion representation approaches: categorical, dimensional and appraisal-based approach. Two approaches are described in this paper: (1) discrete categories represented by a verbal label and (2) dimensional emotions represented by a position, or a set of positions, in a space defined by continuous dimensions. In the next section, both of these approaches are presented in detail. However, the appraisal-based approach is not presented. In this theory, emotions are extracted from event evaluations that cause specific reactions for different people. Therefore, these emotions are considered after the event evaluation. In fact, appraisals are cognitive causes of emotions that give meaning to events and their

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