ARTICLE IN PRESS

Computer Science Review (



Contents lists available at ScienceDirect

Computer Science Review



journal homepage: www.elsevier.com/locate/cosrev

A survey on mobile affective computing

Eugenia Politou*, Efthimios Alepis, Constantinos Patsakis

Department of Informatics, University of Piraeus, Greece

ARTICLE INFO

Article history: Received 17 February 2017 Received in revised form 18 July 2017 Accepted 25 July 2017 Available online xxxx

Keywords: Mobile affective computing Affect recognition Affect detection Smartphone sensors Mobile sensing

Contents

ABSTRACT

The spontaneous recognition of emotional states and personality traits of individuals has been puzzling researchers for years whereas pertinent studies demonstrating the progress in the field, despite their diversity, are still encouraging. This work surveys the most well-known research studies and the state-of-the-art on affect recognition domain based on smartphone acquired data, namely smartphone embed-ded sensors and smartphone usage. Inevitably, supplementary modalities employed in many eminent studies are also reported here for the sake of completeness. Nevertheless, the intention of the survey is threefold; firstly to document all the to-date relevant literature on affect recognition through smartphone modalities, secondly to argue for the full potential of smartphone use in the inference of affect, and thirdly to demonstrate the current research trends towards mobile affective computing.

© 2017 Elsevier Inc. All rights reserved.

1.	Introd	luction	2
	1.1.	Related research	2
	1.2.	Criteria for inclusion in the literature review	2
	1.3.	Road map	3
2.	Backg	round	3
	2.1.	Affective computing	3
		2.1.1. The affective domain	3
		2.1.2. Core affect, emotion, mood, personality and sentiment	3
		2.1.3. Affect modelling, classification and measurement	4
	2.2.	Ubiquitous computing and mobile sensing	6
3.	Mobil	e affective sensing and relevant research	6
	3.1.	Big-Five personality traits recognition	7
	3.2.	Recognition of distinct affective states	7
		3.2.1. Ekman's distinct states model recognition	7
		3.2.2. Stress recognition	10
		3.2.3. Recognition of happiness, boredom and other distinct affective states	11
	3.3.	Recognition of dimensional affective states	12
	3.4.	Recognition of wellbeing and human behaviour models	12
4.	Challe	enges for smartphone affective research	13
	4.1.	Privacy	13
	4.2.	Informed consent	14
	4.3.	Data misuse	14
	4.4.	Trust and engagement	14
	4.5.	Multimodal fusion	15
	4.6.	Resource constraints	15
	4.7.	Affect modelling and representation	15
	4.8.	Cultural differences	16
	4.9.	Cost	16
5.	Discus	ssion and conclusions	16

* Corresponding author. *E-mail addresses:* epolitou@unipi.gr (E. Politou), talepis@unipi.gr (E. Alepis), kpatsak@unipi.gr (C. Patsakis).

http://dx.doi.org/10.1016/j.cosrev.2017.07.002 1574-0137/© 2017 Elsevier Inc. All rights reserved.

2

ARTICLE IN PRESS

References

1. Introduction

Nowadays, various mobile sensing applications demonstrate the progress in Human-Computer Interaction (HCI) by exploiting big data to measure and assess human-behavioural modelling [1,2]. The continuous sensing of smartphone users and the understanding of their interactions with others and the environment is exploited by the modern mobile sensing applications to provide useful services concerning individual and community wellbeing. This research area conceptualises the notions of mobile affective sensing and computing [3,4] for which, during the past decade, extensive and innovative research has commenced worldwide. In the majority of the undertaken experiments the evolution of smart devices, like smartphones, has been utilised so as to collect data about their holders' emotions, moods or sentiments, and to model and classify user's emotional, personality or psychological states. In most of these cases, after extracting suitable features from the sensor data, various machine-learning and data mining techniques are applied to automatically recognise participants' emotions; such as anger and happiness, mood; such as positive and negative mood, or personality traits; such as neuroticism or extraversion.

With regard to data diversity and size, data acquired through smartphone sensors and utilities usually comes in high resolution and spans over multiple modalities such as location, proximity with other objects, collocation with other devices, diversity of contacts or touch behaviour. In addition, smartphone data collection can be done on an unprecedented scale with millions of users in parallel [5]. Given this sheer volume of affective data, many computer scientists and clinical psychologists argue that affective computing can alter the way modern psychology is performed nowadays by inferring people's emotions, moods or states and by providing appropriate and timely interventions. As Miller states in his manifesto [6]:

"smartphones can be used in modern psychology as a research method on its own, because they are ubiquitous, unobtrusive, intimate, sensor rich, computationally powerful, and remotely accessible and therefore they offer huge potential to gather precise, objective, sustained, and ecologically valid data on the real-world behaviours and experiences of millions of people, without requiring them to come into labs".

1.1. Related research

Thus far, despite the remarkable progress in machine analysis of human affect and the immense related body of literature, the problem of recognition and understanding human behaviour and affective status through machines remains complex and hard to be tackled [7]. Apparently, the most prevailing research topics, occupied the scientific community of affect recognition over the past two decades, were the challenge of emotion recognition through visual and audio stimuli and, consequently, the fusion of these two modalities.

One well-known survey on video and audio affect recognition is conducted in [8] where its authors analysed past decade's efforts towards recognition of spontaneous affective expression by using audio and visual information. Heretofore research in emotion recognition based on speech and face expressions has yielded overly fruitful results and inevitably, the majority of existing surveys concentrate on documenting these basic modalities [9–16]. In addition to visual and audio, supplementary modalities have been widely used to infer affect, such as physiological signals [17], text input [18,19], body gestures [20], keyboard strokes and mouse movements [21] and touch behaviour [22,23]. Recently, an overview of the state-of-the-art in audio-, visual- and textualbased multimodal affect recognition has been conducted [24].

Concerning affect recognition studies based on data acquired through smartphones, our research concluded that yet there are not any comprehensive surveys to cover the full range of the growing research efforts. Perhaps the most relevant work is the one carried out by Shmueli et al. [25] where some of the pertinent studies regarding the use of smartphone data for detecting users' emotional states and personality traits are referenced, as well as the one cited in [26] that lists some studies for automatic personality recognition through smartphones. However, these reviews are neither extensive nor in-depth, since their main focus is, as long as the first is concerned, to survey recent advances in computational approaches and to demonstrate how trust is an important building block of computational social systems, whereas as long as the latter is concerned, to review the relevant progress on personality computing in general, and thus to indicatively list some pertinent research works regarding personality recognition through smartphone data.

Predicting users' discrete and isolated emotional states by utilising smartphone capabilities has been the objective of a small number of surveys. One such work concerning the emotional state of happiness is referenced in [27] where its authors compiled a survey of recent studies on happiness prediction by using smartphones and other intelligent devices, aiming at the better understanding of happiness determinants. Nevertheless, the survey examines a single state, happiness, and does not thoroughly cover all the studies performed for the full spectrum of human affective domain. Furthermore, a brief overview of the latest research works in the area of stress recognition can be found in both [28] and [29] whose authors report recent efforts in detecting stress based on data collected from smartphones. However, their works cover a narrow picture of the affective domain and its pertinent studies to date.

Notwithstanding the previous reviews, the current survey attempts to enlighten readers in mobile affect recognition domain by exploring and documenting the full spectrum of relevant research works, something which, to the best of our knowledge, has not been examined before. Beyond citing all the relevant research on mobile affect recognition domain, the survey aims at exposing the full potential of smartphone use in the inference of affect by providing encouraging affect recognition results based on smartphone collected data. Last but not least, the survey contributes in the dissemination of recent progress and radical developments in the field by demonstrating the state-of-the-art and the current research trends towards mobile affective computing.

1.2. Criteria for inclusion in the literature review

The literature review presented and discussed in this survey is based on an extensive search for relevant papers that have been published during the last 7 years, a period characterised with a significant increase in research on affective computing through smartphones and the evolution of mobile sensing technologies. For compiling the current survey, studies regarding the detection of emotions, moods, personalities or other behavioural characteristics, like wellbeing, based on smartphone derived data were taken into account. In this regard, we have deliberately omitted the study of methods which concentrate on the use of basic modalities and

18

Download English Version:

https://daneshyari.com/en/article/4958331

Download Persian Version:

https://daneshyari.com/article/4958331

Daneshyari.com