Affective Computing for Mobile Technologies

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Figure 1: First International Workshop on Affective Computing for Mobile Technologies. Website: https://acimt.github.io/

ABSTRACT

Mobile technologies have become integral to daily life, and understanding users' emotional states during interactions is crucial for enhancing user experience. However, integrating affective perception, behavior analysis, and affective computing for mobile technologies presents multifaceted challenges, ranging from technological limitations to ethical considerations. This workshop proposes a collaborative exploration of cutting-edge solutions for affective computing for mobile technologies. We aim to bring together experts to explore topics such as: user behavior analytics, user experience design, affective computing applications, cultural and contextual considerations, and the ethical implementation of affective computing. This workshop aims to bring together researchers and practitioners from both academia and industry to identify and explore: 1) innovative solutions, 2) novel applications, and 3) key challenges in this area to drive research in the coming decade. The long-term goal is to create a strong interdisciplinary research community that includes researchers and practitioners from HCI, HRI, Ubiquitous Computing, Cognitive Psychology, Mobile Technology, Interaction Techniques, User Privacy, and Design. We envision ongoing research collaborations and accelerating innovations in affective computing for mobile technologies.

CCS CONCEPTS

• **Human-centered computing** → **Ubiquitous and mobile computing**; **Human computer interaction (HCI)**.

KEYWORDS

Affective Computing; Affective Behavior; Emotion; Mobile Technology; Mobile Devices; Ubiquitous Computing; Interaction Techniques; Human-Computer Interaction; Human-Robot Interaction; Human-Drone Interaction; Robotics

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1 INTRODUCTION

Affective computing [25] is a multidisciplinary field that involves areas from computer and cognitive sciences to psychology and beyond. It was initially defined as concerned with the design and development of "computer systems that sense, interpret, adapt, and potentially respond appropriately to human emotions" [21]. In their work, McDuff and Czerwinski [21] described that: 1) systems that respond to social and emotional cues can be more engaging and trusted, and so more socially acceptable; 2) emotionally sentient agents present the exciting potential for large-scale, in-situ experimentation and user experience testing; and 3) designers need to consider the specifications of emotionally-aware systems as an affective agent may raise users' expectations of competence that the system may not possess. The field of affective computing then grew to include all emotion-related research in all types of interactive technologies. These include mobile technologies, from personal devices to AR/VR headsets, wearables, and other on-body devices, in-body devices (e.g., wireless medical devices for body sensing/stimulation), and robots.

In the mobile context, affective computing plays a central role [1, 15, 26]. Previous research has explored various avenues, such as novel user interfaces for computer-mediated emotional communication [19, 29] (e.g., a huggable interface to convey affection [22]), affective sensing and assistive technologies aimed at facilitating depression diagnosis and monitoring [17], as well as wearable devices for micro-smile recognition [24]. While affective computing for mobile technologies holds many opportunities and potential in a range of applications and domains (e.g., [11, 16, 23, 27, 33]) it confronts numerous challenges, ranging from technological and ethical to privacy, security, and social considerations [4, 30]. One evident challenge in the integration of affective computing with mobile technologies arises from the inherent need for these technologies to function seamlessly *on the move, anytime and everywhere* [8, 31, 34]. In addition, different devices' types and form factors present different challenges for interaction, sensing, and perception [7, 12, 13, 19]. For example, in sensing people's emotional states, noise is traditionally introduced in the signal, while the user is moving (e.g., walking, biking). Technological solutions have tried to tackle such issues, such as in cognitive neuroscience, where mobile electroencephalography (EEG) hardware [14] is being explored, including via the development of EEG devices around [2, 18] or in the ear [20], allowing the study of neural processes during daily activities.

Beyond the technical limitations of interacting with mobile affective technologies, there are additional social challenges that need to be considered (e.g., [9, 10]). In social robotics, for instance, concerns have surfaced regarding the potential for emotional deception by robots. This issue is particularly pronounced in the context of users forming emotional attachments to their robots, underscoring the need for comprehensive guidelines [28, 32]. Despite the acknowledged importance of establishing guidelines for emotional interaction with nonhuman agents, their establishment is still pending [6]. Researchers within this domain argued that the introduction of emotional elements to technologies would give rise to ethical, legal, and societal implications [6]. This is even more pronounced with mobile technologies that can be used at any given time and in a wide range of locations with potentially the presence of bystanders.

In recent years, the Mobile Human-Computer Interaction (MobileHCI) community has seen a surge in interest in affective computing (e.g., [3, 5, 8]). As an example, StressShoe, introduced by Elvitigala et al. [5], enables office workers to self-track and manage acute stress through interventions facilitated by a shoe-mounted inertial measurement unit. Other researchers described a mobile phone system for sharing emotions using self-composed melodies [29]. Prior work from the community also highlights various obstacles impeding the advancement of affective computing for mobile technologies. For example, Grzeszczyk et al. [8] address the challenge of applying findings from lab-based studies using wearable devices to real-life situations. They tackle this issue by using consumer-grade wearables and adding self-report measures to improve the automatic detection and tracking of emotional states. While the MobileHCI community shows an increasing interest in affective computing, a dedicated community is lacking to tackle such issues.

With this workshop, we aim to create a dedicated community for researchers and practitioners to address matters of affective computing for mobile technologies. We propose to bring together students, experienced researchers, and practitioners from diverse multidisciplinary areas. We expect this workshop will raise interest in researchers from several fields: affective computing, mobile technologies, interaction design, robotics and human-robot interaction, ubiquitous computing, cognitive psychology, social computing, and human-computer interaction. Through three hands-on sessions and group discussions with experts from both academia and industry, our goal is to address key questions around the design, challenges, and methodologies, and bring a community together to develop new approaches for future research in affective computing for mobile technologies.

2 ORGANIZERS

Our organizing team comprises researchers from multiple disciplines from Australia, Finland, Israel, and Japan.

Jessica R. Cauchard is a faculty member of the Department of Industrial Engineering and Management at Ben Gurion University of the Negev, Israel, where she founded and heads the Magic Lab. Her research is rooted in the fields of Human-Computer and Human-Robot Interaction where she focuses on natural interaction techniques with mobile and wearable devices. Some of her latest work has investigated affective computing in drones and on designing novel technologies that can support people in their everyday lives. Dr. Cauchard received her Ph.D. from the University of Bristol and worked as a postdoctoral scholar at Stanford University and Cornell Tech.

Julien Epps was appointed as a Senior Lecturer at UNSW Electrical Engineering and Telecommunications in 2007, Associate Professor in 2014, and Professor and Head of School in 2019. In 2023 he was appointed Dean of the UNSW Faculty of Engineering. He is also a Co-Director of the NSW Smart Sensing Network (NSSN). He serves as an Associate Editor for IEEE Transactions on Affective Computing, and was a member of the Advisory Board of the ACM Int. Conf. on Multimodal Interaction and the Executive Committee of the Association for the Advancement of Affective Computing. He was a General Chair for the Int. Conf. on Affective Computing and Intelligent Interaction.

Jorge Goncalves is an associate professor at the University of Melbourne where he is part of the Human-Computer Interaction Group. Previously, he worked at the University of Oulu in the Center for Ubiquitous Computing. He received a Ph.D. with distinction (2015) in Computer Science and Engineering from the University of Oulu. His research interests include Ubiquitous computing, crowdsourcing, social computing, affective computing and human-centred AI.

Jonna Häkkilä, the leader of LUX research group, is professor for Industrial Design at the University of Lapland and docent for computer science at University of Oulu. She has earlier ramped up and led research teams at University of Oulu (2012-2014), and Nokia Research Center (2007-2011). She has published 120+ peer reviewed scientific papers on HCI and has received research grants from Horizon 2020, Academy of Finland, Interreg, and Tekes/Business Finland addressing user centric and future oriented research at the cross-section of design and technology. Her research group's works have been exhibited e.g. in Milan Design Week '16 & '17, New York 2018, and awarded at ISWC '16 and '18.

Viviane Herdel (*main contact person for the workshop*) is a Ph.D. candidate within the Department of Industrial Engineering and Management at Ben-Gurion University of the Negev, Israel. She holds a M.Sc. in Neurocognitive Psychology with distinction at the University of Oldenburg, Germany. During her master's studies, Viviane specialized in noninvasive brain imaging and human-computer interaction. In her ongoing Ph.D. research, she explores the role of emotions and their appropriateness in the context of human-drone interaction. Her research interests include emotion research, affective computing, human-computer interaction, social robotics, and user experience research.

Monica Perusquía-Hernández is an assistant professor of HCI and Affective Science at the Nara Institute of Science and Technology, Japan. She specializes on Affective Computing and User Experience Quantification to improve Human-Computer Interaction. Currently, she is working in affective computing, signal processing, and interoceptive awareness enhancement in cyber-physical systems. Her work relies on Computer Vision, EMG, EEG, ECG, and EDA for congruence estimation between facial expressions and emotions.

3 ONLINE TOOLS

We created a website: https://acimt.github.io/ to promote the workshop, which will also serve as a platform to present the findings and foster the growing community. We will also create a Slack channel for participants to introduce themselves, share their ideas and expertise before the workshop, and create an online community that can remain active afterward.

4 PRE-WORKSHOP PLANS

Before the workshop, we will issue a call for participation, advertise the workshop, open a submission form for authors to submit their work, select position papers, and contact authors with relevant information to best prepare for the workshop itself. The call for participation will be broadly distributed to the different research communities addressing the subject of the workshop. This includes posting to mailing lists, on social media, and using the organizers' networks to contact leading researchers with relevant contributions in the area. Potential participants will be asked to submit a two to six-page position paper in the ACM Master Article Templates (documentclass[manuscript,review]{acmart}). Papers may be submitted with organizers as authors or co-authors. We will encourage authors to consider broader implications of affective computing for mobile technologies, and where appropriate, implications for related fields (e.g., privacy, ethics). Participants will be encouraged to bring new perspectives to the MobileHCI community. An Easychair account will be used to submit the position papers. Each paper will be reviewed by at least two of the workshop organizers. The organizers will select high-quality paper submissions for presentation at the workshop. Papers will be selected based on quality and relevance to the workshop topic and goals. Accepted position papers will be uploaded to the workshop website. Participants will be asked to read all of the accepted position papers before the day so that they may come to the workshop primed with relevant questions and discussion points. Each participant will be asked to share a word cloud representing their thoughts and insights about affective computing for mobile technologies on the Slack channel in preparation for the workshop. These word clouds will then be combined on a Miro board used during the workshop.

5 WORKSHOP STRUCTURE

The proposed timeline for the workshop is shown in Table 1. First, the organizers will introduce themselves and talk briefly about the aim and scope of the workshop. Participants will then introduce themselves and their research interests in 1 minute each. After that, the workshop will kick in with an engaging keynote session by a lead researcher in the field.

Group Activity 1: Ice breaker. We will hand out a printed word cloud to each attendee. They will then have to move around the room and find another attendee with at least one common word in their cloud. Once participants are paired, they will have 10 minutes to discuss the words on their cloud and come up with a question or discussion point that they will write on a post-it and pin to a board. The board will be made of a large-size poster with all the keywords presented on the word clouds in the pre-workshop activity. At the end of the activity, one of the organizers will summarize the key insights from the post-its and highlight areas of interest or concern that can be further explored in the second group activity.

Individual Presentations: Each selected paper will get a presentation slot. Each presenter has seven minutes to talk followed by a three minutes Q&A session. Half of the presentations will take place before the coffee break, and half afterward, to ensure that participants pay attention to the presenters. This session will last approximately two hours.

Group Activity 2: Ideation. In this second activity: ideation, each participant will get three post-its that they will use to indicate the topics they find most interesting. This activity aims to build upon the insights gathered from the word cloud exploration to generate novel ideas and exciting challenges for affective computing for mobile technologies. Here, we will divide participants into small groups based on specific themes identified in the first activity. We will ask each group to brainstorm applications and challenges

	Pre-Workshop activity
08:30–08:45	Opening & Welcome
08:45–09:00	1-min introductions
09:00–09:30	Keynote by Prof. Akane Sano
09:30–10:00	Group activity 1: Ice breaker
10.00–11:00	Presentations (Part 1)
11:00–11:30	Coffee break
11.30–12:30	Presentations (Part 2)
12:30–14:30	Lunch break
14:30–15:30	Group activity 2: Ideation
15:30–16:30	Group activity 3: Collaborative storytelling
16:30–17:00	Questions, summary and closing

Table 1: Tentative workshop timeline - full-day session.

around their topics. Each group will then present their findings to the larger group. We will facilitate a discussion on the feasibility, uniqueness, and potential impact of the proposed topics, and encourage constructive feedback and refinement of ideas. At the end of the activity, we will summarize the key ideation outcomes, and discuss how these ideas align with the workshop's long-term goal of driving research and innovation in affective computing for mobile technologies.

Group Activity 3: Collaborative Storytelling – Future Scenarios. In this third activity: Collaborative Storytelling – Future Scenarios, participants will work together in groups to create short stories or scenarios set in a future where affective computing is seamlessly integrated into mobile technologies. This can, for example, be the morning routine of a person from waking up until they leave the house for work. The workshop participants will take turns adding elements to the story, considering technological advancements, societal impacts, and ethical considerations. At the end of this activity, each group has created one persona and the timeline of their routine or a scenario they are in. This will be done in Miro using images to visualize the routine or scenario at hand. After that, each person will showcase their persona and timeline to the other groups. This activity encourages imagination, empathy, and collective visioning of the possibilities and challenges of affective computing in the future. This session will end with a group discussion with all workshop participants.

6 POST-WORKSHOP PLANS

We expect this workshop to influence future research in this area and help establish well-needed methodologies for affective computing for mobile technologies. All accepted submissions will be published on the workshop website and through HAL (https://hal.archives-ouvertes.fr/), which is indexed by Google Scholar. Additionally, we plan to hold an open call in a special issue of a journal.

7 CALL FOR PARTICIPATION

In our increasingly digitized world, mobile technologies have become integral to daily life. As we navigate the challenges and opportunities posed by integrating affective computing into mobile technologies, we provide this emerging field with a platform to bring together researchers and practitioners. This workshop provides a unique opportunity to engage in hands-on sessions and group discussions alongside seasoned experts in the field. We seek high-quality contributions that explore the advances and challenges in affective computing for mobile technologies. Submissions are invited in, but not limited to, the following topics:

- **Emotion Recognition for Mobile Technologies:** Investigating techniques and algorithms for recognizing and understanding emotions based on user interactions, such as facial expressions or behavioral patterns.
- **User Behavior and Emotional Responses:** Analyzing how users' emotional states influence their behavior while interacting with mobile technologies, such as app usage patterns, response times, or engagement levels.
- **Affective Computing Applications:** Discussing practical applications of affective computing in mobile technologies, including personalized user interfaces, adaptive content delivery, or emotion-aware mobile apps.
- **User Experience Design:** Exploring how the integration of affective computing can enhance the overall user experience in mobile technologies by tailoring interfaces and interactions to users' emotional states.
- **Privacy and Ethical Considerations:** Addressing the ethical implications, including privacy concerns related to emotion data collection and potential misuse of emotional insights such as profiling.
- **Technological Challenges and Solutions:** Highlighting challenges associated with implementing affective computing on resource-constrained mobile technologies and proposing solutions or advancements in technology.
- **Human-Robot Interaction (HRI):** Investigating the impact of affective computing, particularly in the context of mobile robots, and discussing how emotional understanding can improve interaction with humans.
- **Cultural and Contextual Considerations:** Examining how cultural differences and contextual factors influence the effectiveness of affective computing algorithms and applications in diverse mobile user populations.

Authors are invited to submit a two to six-page (excluding references) position paper following the ACM Master Article Templates (documentclass[manuscript,review]{acmart}). We will select submissions based on quality; if accepted, papers will be featured on our website (https://acimt.github.io/) and published through HAL (https://hal.archives-ouvertes.fr/), which is indexed by Google Scholar. At least one author must attend the workshop. All participants must register for the workshop and at least one day of the conference. Submissions are to be submitted via EasyChair. Participants who are unable or prefer not to submit a position paper to the workshop have the option to submit a one-page statement of interest instead. This statement should outline the applicant's interest in participating, their relevance to the workshop, and their anticipated contributions.

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