Intelligent Notification and Attention Management on Mobile Devices

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Abstract

Today, many users of mobile devices are continuously con-
fronted with a huge variety of information: notifications
from Facebook, new application updates, won badges, or
reminders. This leads to an information overload, which
makes it hard to stay focused. This workshop will inves-
tigate approaches towards smart attention management
systems. We will discuss the fundamental challenges of
smart notifications and the design of proactive notification
mechanisms. We invite submissions that focus on the un-
derstanding of users and their current, mobile information
handling. We further appreciate contributions that propose
design concepts for the interaction with smart attention
management systems. The expected workshop outcome
is a summary of emerging challenges in the design and de-
velopment of smart attention management systems as well
as approaches to address them.

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Attention management; smart systems; mobile devices;
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Miscellaneous

Figure 1: A screenshot of an Android lock screen, which is filled with update, advertisement, and system status notifications.

Introduction

Over the last decade, smartphones became pervasive personalized devices that are within their owner's reach virtually all the time. Smartphones are used throughout the day [3] for purposes that go well beyond simple voice communication. Devices come with essential pre-installed applications, such as the actual phone dialer and a calendar, yet, a plethora of additional apps can be installed on a smartphone – the Apple App Store alone hosts more than 1.3 million different apps.

Almost all of these mobile applications and services regularly and actively provide users with information, updates and notifications [14, 17]. Facebook notifies us when our name is mention in a post, the calendar reminds us of the birthdays of family and friends, and other applications tell us about any recent updates and related features (see Figure 1). In the process, the phone uses a number of different modalities to attract our attention: it beeps and turns its display on, the vibration buzzes, and a message appears on the lock screen, in the notification bar or anywhere else on the phone's screen. Moreover, with the recent availability of companion devices, such as smartwatches or smart televisions, as well as ambient pervasive devices, the information reach has further expanded, confronting users with newest insights on their wrist or while watching TV [22].

Altogether, mobile applications are selfishly trying to get a human's attention and to make him/her interact with the application. This is done despite the knowledge that a human's attention is a limited resource. In fact, the scarcity of human attention has been recognized, and the term *attention economy* has been coined. Thereby, the number of "eye-balls" that a service attracts has become a prime metric for its market valuation. Consequently, online services and their applications are incentivized to attract as many

people as possible for as much time as possible.

With all this information it is getting increasingly more exhausting to pay attention and respond to incoming information in appropriate ways. In addition, the presence of so many different applications and services makes it difficult to choose the best and most appropriate notification to respond to, which can lead to stress and frustration. Eventually, this results in the problems of *digital burnout*, *information overload*, and *overchoice*—in our opinion some of the most relevant problems in information technology for the next few decades. If we do not address the problems early on, we risk reduced mobile communication technology growth due to serious usability issues.

Existing research efforts have concentrated on the understanding of users and their mobile information handling [6, 8, 12, 14]. Further, the prediction of opportune moments to issue notifications was studied [5, 15], and design concepts and use cases for such anticipatory systems were sketched [13]. This workshop intends to assess the current state of the art, and to identify emerging challenges on the way towards smart attention management systems.

Workshop Goals

The goal of this workshop is to discuss how digital burnout due to the ubiquitous company of smart devices, information overload and overchoice through the flood of mobile notifications affect the users' experiences, and how artificial intelligence, adaptive user interfaces, and clever, multimodal interaction techniques can help them to focus on the most essential information. Further, we want to discuss various meta-aspects of these smart attention management systems, for example, how they can be configured, trusted or how their dynamics can be communicated to the users. The workshop is not restricted to single device en-

vironments. Instead, we plan to discuss our insights in the light of future multi-device environments and ambient notifications. The overall objective is to identify and summarize emerging challenges in the design and development of smart attention management systems.

In this workshop, we bring together people from industry and academia who are active in areas like attention research, context-aware computing or multimodal interaction. Through presentations, discussions, and a structured wrap-up session we want to conclude with an overview of recent and future challenges in smart attention management, and potential ways to overcome them. This workshop will be the fifth installment of a series of similar workshops on the conferences MobileHCI [16, 23] and UbiComp [10, 21]. All workshops attracted a large number of workshop submissions and participants, highlighting the importance of the topic. Similar to the previous workshops, papers and presentations as well as a workshop summary with key findings will be published on the workshop website. Further, it is planned to co-author a summative paper with interested workshop participants.

Topics of Interest

The workshop invites diverse submissions that study the workshop topic from various perspectives. We welcome submissions which aim to understand users and attention-related aspects, e.g., when [14] and where [4] do users attend notifications, how do users set their ringer mode switch, or the costs of interruptions [8]. Thereby, submissions could focus on the plain understanding of the matter or intend to contribute a first predicting model [15]. Further, we appreciate any submissions, that propose or investigate design solutions, strategies or concepts how the above-mentioned problems can be addressed, e.g., a lock screen replacement or an anticipatory design concept [1, 13].

Future smart attention management systems will likely come with a complex logic, e.g., a machine learning algorithm, which will dynamically modify information flows and user experiences [11]. Thus, we also look forward to submissions that address and study any meta-aspects, e.g., how smart systems can be configured, how their state can be communicated to users, to what extent users are able to trust such a smart system, and how training data can be collected [19].

Given the increasing distribution and handling of notifications on external computers or companion devices, e.g., smartwatches, wearables and televisions, we explicitly invite research contributions that focus on attention management in multi-device environments [24], smart homes [20], and the Internet of Things (IoT) [7]. Contributions could, for example, study, how users distribute their notifications [17], or which multi-device interactions would enable more targeted interactions [2, 9, 18].

The following list gives an overview which topics are—among others—of relevance for the workshop.

- Understanding mobile information needs, mobile notifications, mobile attention behavior
- Detection/prediction of availability and attention
- Detection/prediction of information perception, information overload
- Multimodal interaction with focus on attention optimization
- Interaction across devices, multi-device interaction
- Context-adaptive or context-aware user interfaces
- Infrastructures, frameworks and tools for the development of smart attention systems

Expected Outcomes & Future Directions

The contributions on the understanding of users and their interaction with information will define how future smart attention management systems should behave, so that they ideally meet the users' needs. Design-related contributions will illustrate concepts and principles, how related interactions and operations may look like, and how the users will work with smart, adaptive user interfaces. Contributions on meta-aspects will give ideas how smart attention systems can be visualized or configured. These contributions alone will be made available on the workshop website, and will, therefore, inspire the research community and point out ideas for future research projects.

In addition, the discussions at the workshop will be summarized and will lead to an overview of the emerging challenges in the understanding, design, development, and deployment of smart attention management systems. This summary will probably contain a list of relevant research areas, a brief summary of the area's state of the art, and which research contributions and collaborations would be necessary to enable the creation of a comprehensive, deployable smart system. The summary will be made available on the workshop website and will serve as a research agenda for future research on smart attention systems in the next few years.

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