Context Awareness in Mobile Computing

Andreas Zinnen

Technical University Darmstadt
TUD - FB 20
Multimodal Interactive Systems
Hochschulstraße 10
D-64289 Darmstadt
Germany

++49 6151 16 6227
zinnen@mis.tu-darmstadt.de

PhD-Supervision: **Prof. Dr. Bernt Schiele**

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Abstract
Emerging applications in the field of mobile, wearable or ubiquitous computing try to include more of the user's context in order to better adapt the user interface (UI) to the user. Ideally, the computer would proactively act on the user's behalf. Within my PhD, I would like to identify which kind of context information is interesting within the scope of UIs and how this information can be used to customize the interaction between users and the system. Beyond context awareness, wearable devices require alternative input devices, e.g. sensor based gesture control. To support various types of devices, gestures ideally should be customizable, easy and quick to train.

Keywords
Context awareness, alternative human-computer interaction, gesture recognition

Problem Statement and Research Question
Gesturing is a natural form of communication. In many situations, users of a computer system cannot use a common mouse or a keyboard. Appliance of wearable computing in mobile settings requires alternative human computer interaction since computing and communication devices become smaller, lighter and more powerful. Speech recognition is not adequate in

many scenarios, e.g. doctors in health care [6] or noisy environments.

Alternatively, gesture recognition has been studied in various ways using a cap-mounted camera [5] or a glove-based system [3] to recognize sign languages. Acceleration based gesture interfaces are quite recent. In [4], the authors enable fast and effortless customisation in accelerometer based gesture interaction using discrete Hidden Markov Models. Most of the published papers about gesture recognition consider the recognition accuracy of a set of different gestures. I will extend this approach by investigating the gestures which are occurring in daily life to find distinguishable gestures for a Human Computer Interface. Ideally, those gestures should be easy and quick to train for everybody. Furthermore, the identified restricted set of gestures needs to be socially accepted to be used in daily life or work environments. Analyzing the non- and wrong-detection rate of the found gestures within daily life will be the most challenging part of the research. This set of gestures hopefully will offer a way to use gesture interaction without explicitly activating and deactivating the recognition system.

In a next step, I am interested in context information within the scope of UIs and how this information can be used to adapt the interaction between users and the system. Similar to the methodology proposed in [1], I aim to focus on applications that benefit from context-aware services. A central question in this area is the dynamic usage of context information within the software development process.

Approach and Methodology

As a prerequisite for acquisition of long term recording data of social gestures, a mobile sensor platform shall be set up. The goal is to have a mobile and stable recording platform, able to record 12+ h of sensor data in daily life without the need of a bulky backpack. In a next step, Hidden Markov Models will be used to train gesture recognition. The choice of features is crucial to obtain an acceptable non- and false detection rate of the chosen gestures.

Using this platform, we will gain the necessary data to evaluate the extracted set of gestures in an experimental way. The evaluation of their acceptance and directness will be analyzed in user studies with both students and doctors in the WearIT@Work project [6].

Finally, the research on concepts and methods for utilizing context information will be part of CESORA, a project between TUD and SAP. The design and prototyping of a context engine and the development of example applications based on business processes will consider and compare existing approaches [2].

Related Work

The authors of the paper “Context-awareness in wearable and ubiquitous computing” [1] present a research agenda on context-aware computing. They introduce mechanisms and architectures to support context-awareness and justify their effectiveness through case studies on applications that benefit from context-aware services. Context-aware computing is defined as "any attempt to use knowledge of a user's physical, social, informational and even emotional state

as input to adapt the behaviour of one or more computational services".

“A Wearable Computer Based American Sign Language Recognizer” [5] describes a research effort to make a wearable computer that can recognize American Sign Language using a cap mounted camera for input. The language is interpreted using Hidden Markov Models and includes a set of forty words divided into the categories pronoun, verb, noun and adjective. The authors have achieved low error rates on both the training and an independent test set.

Anind K. Dey presents a context toolkit [2] providing important abstractions and support for the field of context-aware computing. The toolkit integrates input from several distributed computers. An additional layer transforms the context data to a form required by the context-aware applications. Context information is provided to multiple context-aware applications in the framework. The toolkit consists of three main abstractions – the widgets, aggregators and interpreters. Applications accessing the toolkit don’t need to know whether these context components are being executed remotely or locally.

Preliminary Results

N/A

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