Micro Manage Me! – Peripheral Context Annotation for Efficient Time Management

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Abstract. Planning ahead in a world that seems to get more complex every day can be a challenging task. PIM (Personal Information Management) applications try to minimize the mental work load, but are too cumbersome for planning rather insignificant tasks. Due to its static nature, PIM data is prone to unforeseen changes in the real world and therefore require a certain amount of precognition to be planned successfully. Systems exist that use sensor data to derive a rough sense of context in order to proactively show notifications when certain triggers occur. In contrast to that, the proposed system leverages peripheral interaction with physical tags to gain qualitative information on a user's current situation and intents. It uses the data to suggest an efficient order of completion for even small tasks that otherwise would have been regarded too insignificant to plan.
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1 Introduction

In daily life people are confronted with an ever growing number of things to keep track of: Appointments to attend, mails to read, chores, pledges and things always longed to do.

In order to overcome that complexity of life calendars, to-do lists, memos and PIM (Personal Information Management) software is used. And still a certain complexity of use remains: Techniques like setting up appointments in a calendar to finish tasks at the right time are common practice, as well as meta techniques and self-management practices like GTD (Getting Things Done). But due to their static nature, calendar appointments are prone to unforeseen changes in a user's immediate schedule and hence require a high precognition to be planned successfully. Furthermore, the time overhead for explicitly planning a task (pulling out the device, switching it on, starting the PIM application, entering text, putting the device back) creates a new class of tasks which are considered too insignificant to plan this way. Those are then kept in mind and tend to be forgotten.

Other tasks can only be completed under given preconditions or only in certain places, so they are kept in to-do lists hoping to be read at the right time and in the right place. In order for an automatic system to work proactively in those situations, it has to make assumptions on what the current situation actually is. These systems rely on sensors or external data sources (e.g. position, time, weather forecast) to estimate a user's context and show reminders. But since this context is algorithmically derived from continuous sensor data, it might not correctly reflect the user's real immediate situation, like entering or leaving a room, because of the limited (temporal or spacial) resolution of their sensors.

This demands for a system that can precisely capture the user's context and respond to changes in real-time. This is achieved by incorporating explicit user actions that happen in the periphery of attention while (or even before) the context change is actually happening.

2 Proposed System

Instead of relying merely on context information derived from quantitative sensor data, the proposed system leverages physical tags (bar codes, QR tags and/or RFID tags) that are peripherally scanned in order to gain more qualitative context information on what the user is doing right now or even planning on doing next. Since these context tags, or "ConTags", are explicitly scanned by the user, they are expected to convey a higher feeling of control and less lag than existing proactive task planners that are not triggered by explicit user actions.

ConTags can not only signal that the user is entering a new situation, they can also be used to plan new tasks, like "empty the trash" by scanning the corresponding ConTag that is conveniently placed at the trash can. Having such a fine grain of information on what a user is (planning on) doing –like leaving for work, going to the bathroom or sitting down to do some work– the system can propose an execution pipeline for the most efficient time and order that tasks could be done.

The goal is to create a system that works in the background, capturing information on the user's current and planned tasks, and only springs into attention when it found a task that best fits into the user's immediate schedule, context and free resources.

Wrist worn smart watches, equipped with suitable sensors for reading the context tags peripherally, is used in a first prototype. Data is processed either on the watch itself or on a wirelessly attached smart phone. Notifications are conveyed to the user using the smart watch display, sound, vibration and/or a connected head up display. The optimal mode of notification is still to be evaluated.

Fig. 1. Prototype using acoustic bar codes (top left) and smart watches equipped with a camera (top right) and microphone (bottom)

3 Related Work

A key aspect of the proposed system is the peripheral nature of the interaction, meaning that it is designed to be done in parallel to a main task [8], causing only micro-interruptions or no interruption of the main task at all [2][5]. This attribute sets the proposed system apart from other context annotation systems [6] that require the user's full attention while entering data. The complexity of interaction and hence the mental resources needed to complete the side task strongly affects how well it can be done peripherally or automatically [1], and how it impacts the performance of the main task. That's why ergonomics must also be taken into consideration when selecting technologies for peripherally annotating context.

4 Peripherally Annotating Context

Capturing information on the user's context is a crucial and challenging task for this system. Asking the user to annotate each action using text entry or speech input requires too much engagement and is therefore considered not to be peripheral (happening at the periphery of attention).

Using RFID tags and a body-worn reader seems to be a more subtle approach than text entry, but carrying an always-on RFID antenna near the body might bring power consumption problems as well as raise health concerns. Requiring users to pull out and activate an NFC enabled smart phone for every action they do is not considered peripheral and would impact the intended use of the system. RFID technology can,

however, be incorporated into the system for annotating situations where the user's action itself leverages RFID technology, like checking in to work using an RFID pass.

Printed 1D or 2D bar codes, like RFID tags, can be read without physical contact, but require a camera to be pointed at them on every use [7]. This, again, would require the user to pull out and activate a camera phone or wear an always-on camera [3][9] which raises privacy and power consumption concerns. But since bar codes are easy to produce and already incorporated into a variety of products, optical scanning of bar codes can optionally be incorporated into the system for capturing interaction with said products, like "having a reading break" by scanning a book or "having breakfast" by scanning the cereal box.

Another method that combines the advantages of being rather easy to produce and requiring less power than RFID while being always-on, is the use of acoustic bar codes [3]: Like a printed bar code, information is stored in a series of lines, but instead of black lines on white background, acoustic bar codes use grooves that are engraved along the surface of an (3d printed) object. These grooves can be read by scratching a microphone over them and capturing the resulting clicking sounds. The relative temporal distance between these clicks can be decoded back to binary information. Although privacy concerns might still raise from carrying an always-on audio recording device, the system requires only a small amount of power for recording audio and can easily be implemented into wearable devices like smart watches. Swiping the hand across a surface is expected to be a rather non-engaging action, classifying context annotation using acoustic bar codes as a viable peripheral interaction.

5 Intended Use

Having detailed information on the user's context allows a PIM system to better estimate whether a reminder is suitable and worth interrupting the user in the current situation. It can also be used to input new information, like adding tags to business cards or calendars to signal a new appointment when swiping it.

Incorporating this kind of context information might also pose interesting for micro blogging and live journal applications, because ConTags are not limited to carrying ad-hoc information, but can also signal what a user is about to do next, like leaving home, finishing work or meeting other people. This is ideally implemented by adding tags to physical objects that are directly connected to the intended action, like a ConTag on the door handle for signaling leaving the room or ConTags on the bed stand for signaling going to and out of bed.

Using that data the system can, for example, recommend to take out the trash once it has been marked as "full" just in time when the user is about to leave the room or switch all systems to silent mode the second a user gets into bed.

6 Open Questions

By the time this document is written, the prototype is not yet ready for evaluation. Experiments are planned to investigate, among others, the following questions:

- Ergonomics: How does the mere presence of the context annotation device affect users in the completion of a set of common tasks?
- Peripheral Interaction: How does the annotation task impact the completion of the main task? Is it disruptive? Does it cause significant time overhead?
- Optimization: How can the collected data be best used to optimize a user's schedule?
- Future Work: How can other fields of research profit from having timely and accurate context information?

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Appendix: Biography

Bernhard Slawik is a first year PhD student at the Human-Computer-Interaction Group at the University of Munich (LMU), Germany. His research focuses mainly on wearable computing and its social implications.
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