Project proposal for MSc Embedded Systems

TU Delft – Interactive Intelligence

Finding Appropriate Moments for Support in Socially Adaptive Electronic Partners

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# Synopsis

This study will focus on finding what defines an appropriate moment in regards to providing support through a Social Adaptive Electronic Partner (SAEP).

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# 1 Project fundamentals

## Introduction

The use of technology to support the daily lives of people is an ever prevalent topic. Through applications in smart homes, wearables, virtual coaches and many others, we can improve our health, efficiency and be more connected. Conversely, the abundance of apps and notifications cause us to grow immune to the constant stream of information that is presented to us in a daily basis. [1]Especially the elderly or people with a mental impairment could benefit from an effective support agent. [2]–[7] In order to create a truly effective support agent, it is crucial to not only generate feedback in relation to the user’s actions, but provide this feedback at an appropriate time.

But what actually is an appropriate time? The appropriate time for feedback is inherently linked to the nature of the user’s action. To illustrate this, consider the following examples.

1. An elderly lady, Joanna, forgets to call an important client during the day. She wants to be reminded the next day at work.
2. An elderly gentleman, Peter, forgets to take his medicine. Since he has high blood pressure, timely consumption is of importance.

In the first example, a simple reminder notification will suffice. A naïve solution would be to use a simple alarm or reminder app in which she sets a time that deemed appropriate. However, what happens if the next day, that time is no longer appropriate because, for example, a meeting is planned. Most likely, she will read and immediately ignore the message, forgetting about it once again because at that moment, the meeting has a higher value to her. Ideally, her phone would analyze her schedule and remind her outside of meetings and before the end the day.

In the second example, prompt notification is of the essence. Due to the action’s high value, almost any action should be interrupted for this. However, the intake of medicine is also very predictable. So rather than interrupting any activity, the moment should be preempted and any interruptions should be avoided.

The difficulty of this lies in the generalization. While the above examples can be implemented relatively easy at design time, it is likely not to be able to handle diversions from normal behavior. Existing technologies are often made by hardwiring norms and as such are very rigid und unable to adapt to evolving norms. [8] Furthermore, dealing with different problems, such as remembering to turn on the alarm system before leaving work, would require a completely different implementation. Nonetheless, generalization requires analysis of goals and the values the user’s daily activities.

## State of the art

The concept of a Socially Adaptive Electronic Partner (SAEP) has been previously introduced by van Riemsdijk. [8] It follows the ideology that technology should adapt to the user and not vice versa. As such, its logic incorporates the norms and values of the social context. Subsequent work has been done expanding on this, including temporal logic and analyzing actions and habits. [9]–[11].

### Existing implementations

More and more apps are taking advantage of the increased use of smart devices and services in order to get a more accurate picture of the user’s activities of daily living (ADL). Examples include:

Olisto/IFTTT [12], [13] Can combine date, location and smart device information to, for example, give reminders when leaving home and a specific power consumption is still high (i.e. the TV is still on) and subsequently turn it off.

Maps/Waze [14]–[16] Combines real-time traffic information and address in calendar events to provide timely departure reminders.

Timeful [17] Combines user activity, calendar and to-do items to estimate duration of to-do items, plan them in and generate reminders at off-peak times.

While very promising implementations, most apps predominantly rely on design time logic. Exceptions to this usually create a predictive model and verify this with the user in order to strengthen the model. [17], [18]

### Prior research

There have been various approaches as how and when to provide feedback to the user. Generally, the preferred method of feedback is “smart reminders”. [19] Similar to the implementations, papers frequently focus on finding novel ways of combining information from smart devices into producing reminders, following norms provided at design time. Examples include combinations of location and time [20]–[22], events based on smart devices [3], [23], [24], or a combination of numerous sources of information [25]–[27].

The more innovative ideas add an extra logic layer on top of the data of the user’s ADL. Analyzing the user’s values is an intrinsic part of establishing a model. A simple but tedious approach is to ask for user feedback whenever values are needed. Instead, Zhou et al. [28] use a fuzzy linguistic approach to determine value levels.

Rather than specifying norms at design time, they are constructed based on the ADL. Several approaches are proposed. Chaminda et al. [29] suggest coupling complex activities that have a strong relationship among initiation and conclusion, such as closing the tap after opening it. Other papers [2], [30] support this analysis of temporal relationships between activities, in order to generate a set of norms for the support agent. Other context-aware approaches vary greatly. For example, Vurgun et al. [31] apply a dynamic Bayesian statistical approach. Giorgini et al. [32] use label propagation algorithms to break down goals and identify all prior actions necessary to achieve the goal.

Another approach for this makes use of Behavior Change Support Systems (BCSS) [33] by applying principles of Human Computer Interaction (HCI) [34]. This practice is used increasingly in health focused applications to make sense of the abundance of data. Examples of applications [35], [36] share large similarities with the analysis of the user’s norms and values.

## Research description

The research in this thesis will focus on combining the concepts of a SAEP and expanding on the existing research as discussed before. The overall research question is:

Given a user’s daily activity, what is considered an appropriate time for support feedback, taking into consideration the user’s norms and values?

The expected outcome of this question is a generic model which adaptively schedules giving support feedback. In support of creating such a model, several sub-questions are defined:

R1: What are the possibilities of defining and modelling an “appropriate time” according to the user’s values?

R2: How can a scenario be modelled using a technique found in R1?

R3: How can the goal be broken down into a number of norms?

R4: How can the model and norms be combined to indicate an appropriate time?

# 2 Planning

## Staging

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## Deliverables

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## Risk analysis

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## Time planning

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# 3 Personalia

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## Supervision

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## Time planning

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