Project proposal for MSc Embedded Systems
TU Delft – Interactive Intelligence

Finding Appropriate Moments for Support in Socially Adaptive Electronic Partners

Remy Kabel – Supervised by Dr. M. Birna van Riemsdijk

19-04-2018

Synopsis

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

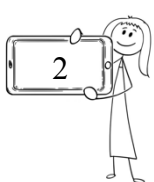
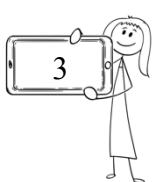


Table of Contents



1
Project fundamentals

1.1 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.

i) An elderly lady, Joanna, forgets to call an important client during the day. She wants to be reminded the next day at work.

ii) 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.

1.2 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].

1.2.1 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]

1.2.2 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.

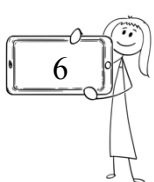
1.3 Research description

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

2.1 Staging

Lorem ipsum

2.2 Deliverables

Lorem ipsum

2.3 Risk analysis

Lorem ipsum

2.4 Time planning

Lorem ipsum

3
Personalia

2.5 Contact details

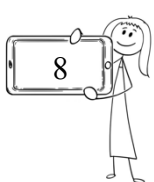
Student		Supervisor	
Name:	Remy Kabel	**Name:**	Dr. M. Birna van Riemsdijk
Email:	r.kabel@student.tudelft.nl	**Email:**	m.b.vanriemsdijk@tudelft.nl
Phone:	+31-(0)6-50655612	**Phone:**	+31-(0)15-2786331
Student no:	4132165	**Office:**	Room W6.680 Van Mourik Broekmanweg 6 2628 XE Delft

2.6 Supervision

Lorem ipsum

2.7 Time planning

Lorem ipsum



4

References

[1] T. Okoshi, H. Nozaki, J. Nakazawa, H. Tokuda, J. Ramos, and A. K. Dey, "Towards attention-aware adaptive notification on smart phones," *Pervasive Mob. Comput.*, vol. 26, pp. 17–34, Feb. 2016.

[2] L. S. Shafti, P. A. Haya, M. García-Herranz, and X. Alamán, "Personal Ambient Intelligent Reminder for People with Cognitive Disabilities," in *Ambient Assisted Living and Home Care*, 2012, pp. 383–390.

[3] J. K. Zao, M. Y. Wang, P. Tsai, and J. W. S. Liu, "Smart phone based medicine in-take scheduler, reminder and monitor," in *The 12th IEEE International Conference on e-Health Networking, Applications and Services*, 2010, pp. 162–168.

[4] A. Arcelus, M. H. Jones, R. Goubran, and F. Knoefel, "Integration of Smart Home Technologies in a Health Monitoring System for the Elderly," in *21st International Conference on Advanced Information Networking and Applications Workshops, 2007, AINAW '07*, 2007, vol. 2, pp. 820–825.

[5] W. Jih, J. Y. Hsu, and T.-M. Tsai, "Context-Aware Service Integration for Elderly Care in A Smart Environment," 2006.

[6] N. Mitabe and N. Shinomiya, "Support system for elderly care with ambient sensors in indoor environment," in *2017 Eleventh International Conference on Sensing Technology (ICST)*, 2017, pp. 1–4.

[7] M. Neerincx, M. Tielman, C. Horsch, W.-P. Brinkman, K. Bosch, and R. J. Beun, "Virtual Health Agents," 2015.

[8] M. B. van Riemsdijk, C. M. Jonker, and V. Lesser, "Creating Socially Adaptive Electronic Partners: Interaction, Reasoning and Ethical Challenges," in *Proceedings of the 2015 International Conference on Autonomous Agents and Multiagent Systems*, Richland, SC, 2015, pp. 1201–1206.

[9] M. S. Kließ and M. B. van Riemsdijk, "Requirements for a Temporal Logic of Daily Activities for Supportive Technology."

[10] P. Pasotti, M. B. van Riemsdijk, and C. M. Jonker, "Representing human habits: towards a habit support agent," in *Proceedings of the 10th International workshop on Normative Multiagent Systems (NorMAS'16)*, 2016.

[11] P. Pasotti, C. M. Jonker, and M. B. van Riemsdijk, "Towards a formalisation of Action Identification Hierarchies∗ ."

[12] "Olisto makes smart thing smarter, according to your rules.," *Olisto*. [Online]. Available: https://olisto.com/. [Accessed: 19-Apr-2018].

[13] IFTTT, "IFTTT helps your apps and devices work together." [Online]. Available: https://ifttt.com. [Accessed: 19-Apr-2018].

[14] "Maps - Navigation & Transit - Apps on Google Play." [Online]. Available: https://play.google.com/store/apps/details?id=com.google.android.apps.maps&hl=en. [Accessed: 19-Apr-2018].

[15] "Free Community-based GPS, Maps & Traffic Navigation App | Waze." [Online]. Available: https://www.waze.com/en. [Accessed: 19-Apr-2018].

[16] Peter G. Chin, "Smart reminders," 25-Mar-2005.

[17] "Timeful," *Internet Archive*, 02-Mar-2015. [Online]. Available: https://web.archive.org/web/20150302091124/http://www.timeful.com/. [Accessed: 19-Apr-2018].

[18] N. Clarkson, "Spotify to predict the music you want to listen to," *Virgin*, 19-Nov-2014. [Online]. Available: https://www.virgin.com/music/spotify-to-predict-the-music-you-want-to-listen-to. [Accessed: 19-Apr-2018].

[19] F. Kargl, B. Dong, T. Illmann, and M. Weber, *Smart Reminder - Personal Assistance in a Mobile Computing Environment*. 2002.

[20] A. Robertson, "Location/time-based reminder for personal electronic devices," 06-Dec-2000.

[21] Jason F. Hunzinger, "Location specific reminders for wireless mobiles," 15-Nov-2001.

[22] Michael Sean McGee, Michael S. McIntyre, and James Randall Walker, "Generating an alarm based on location and time," 17-Apr-2003.

[23] S. W. Kim, M. C. Kim, S. H. Park, Y. K. Jin, and W. S. Choi, "Gate Reminder: A Design Case of a Smart Reminder," in *Proceedings of the 5th Conference on Designing Interactive Systems: Processes, Practices, Methods, and Techniques*, New York, NY, USA, 2004, pp. 81–90.

[24] S. Helal, C. Giraldo, Y. Kaddoura, C. Lee, H. El Zabadani, and W. Mann, "Smart Phone Based Cognitive Assistant," Apr. 2018.

[25] D. Zhang, M. Hariz, and M. Mokhtari, "Assisting Elders with Mild Dementia Staying at Home," in *2008 Sixth Annual IEEE International Conference on Pervasive Computing and Communications (PerCom)*, 2008, pp. 692–697.

[26] M. Philipose *et al.*, "Inferring activities from interactions with objects," *IEEE Pervasive Comput.*, vol. 3, no. 4, pp. 50–57, Oct. 2004.

[27] A. Hristova, A. M. Bernardos, and J. R. Casar, "Context-aware services for ambient assisted living: A case-study," in *2008 First International Symposium on Applied Sciences on Biomedical and Communication Technologies*, 2008, pp. 1–5.
[28] S. Zhou, C.-H. Chu, Z. Yu, and J. Kim, "A context-aware reminder system for elders based on fuzzy linguistic approach," *Expert Syst. Appl.*, vol. 39, no. 10, pp. 9411–9419, Aug. 2012.
[29] H. T. Chaminda, V. Klyuev, and K. Naruse, "A smart reminder system for complex human activities," in *2012 14th International Conference on Advanced Communication Technology (ICACT)*, 2012, pp. 235–240.
[30] E. Nazerfard, P. Rashidi, and D. J. Cook, "Using Association Rule Mining to Discover Temporal Relations of Daily Activities," in *Toward Useful Services for Elderly and People with Disabilities*, 2011, pp. 49–56.
[31] S. Vurgun, M. Philipose, and M. Pavel, "A Statistical Reasoning System for Medication Prompting," in *UbiComp 2007: Ubiquitous Computing*, 2007, pp. 1–18.
[32] P. Giorgini, J. Mylopoulos, E. Nicchiarelli, and R. Sebastiani, "Reasoning with Goal Models," in *Conceptual Modeling — ER 2002*, 2002, pp. 167–181.
[33] H. Oinas-Kukkonen, "A foundation for the study of behavior change support systems," *Pers. Ubiquitous Comput.*, vol. 17, no. 6, pp. 1223–1235, Aug. 2013.
[34] R. Klaassen, "HCI Perspectives on Behavior Change Support Systems," Feb. 2015.
[35] A. Fritzen, N. Leipold, N. Terzimehic, M. Böhm, and H. Krcmar, "HeadacheCoach: Towards Headache Prevention by Sensing and Making Sense of Personal Lifestyle Data," 2017.
[36] E. S. Poole, "HCI and mobile health interventions," *Transl. Behav. Med.*, vol. 3, no. 4, pp. 402–405, Dec. 2013.