Motivating University Students Using a Location-Aware Time Management System with Social Networking Features

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Abstract: Time management in university learning environments can be different from that in the professional workplace or at school. Students are required to learn independently, many learning activities take place outside the formal teaching timetable, and students might require additional motivation to embark on learning tasks. In this paper, we present the design of a time management system prototype addressing these special requirements. Our system incorporates social networking features, enhanced social presence with location awareness, and motivational techniques. Individual learning task progress data is disclosed to associated students, enabling them to assess their own progress and seek help from their peers if necessary. Furthermore, their current geographical position and that of their peers is shown on a virtual map. We use this prototype in an experiment involving 55 students studying on a computer science or information technology in organisations undergraduate degree in their first year. Our research objectives are to test the effects of the system on academic performance, and to evaluate whether system use affects personal stress and learner motivation.

1 Introduction

Contemporary study advice literature stresses the importance of time management for independent learning. This is due to the university learning environment being less structured than in professional work or secondary school, and many learning activities take place outside of the formal teaching timetable (Payne & Whittaker 2000). It is claimed that good time management results in increased employability (Cottrell 2003, Payne & Whittaker 2000), less stress and feelings of guilt, more self-confidence (Payne & Whittaker, 2000), and more control over both study and leisure time (Payne & Whittaker 2000, Cottrell 2003, Saunders 1994). Drew & Bingman (2001) also suggest that it yields more and higher quality output, leading to higher productivity and performance.

These claims are supported by empirical evidence: Britton & Tesser (1991) found a strong and positive correlation between time management components “time attitude” and “short-range planning” with academic performance. Similarly, Macan (1990) found that the application of time management practices leads to students reporting higher performance, more control over time, and less stress. However, there is also evidence that many students struggle with time management. As reported in (Main, 1980), the most common “complaint of students of all ages, levels of study and disciplines, is difficulty in organising and timetabling their work”.

At the University of Southampton, we are currently running an experiment with the aim of supporting student time management by using information technology, building up on previous work in this area (Rebenich & Gravell 2008). First, we conducted a survey about students' current time management behaviour, electronic devices they own and carry on campus, and calendaring applications and features they use for personal time management. Our study involved 137 out of a potential 1200 students studying on a degree in the School of Electronics and Computer Science (ECS) at the University of Southampton, and we obtained the following main results (Rebenich et al. 2010a):

All participants own at least one mobile device, and 76% carry a web-enabled device on campus at least sometimes (the third on a 4-item scale ranging from "never" to "often"). The majority of participants (55.7%) use calendaring software on their mobile device, followed by Google Calendar (40.5%) and Microsoft Outlook (30.5%). The most used calendaring features are appointments and tasks with 77.1% and 64.1%, respectively, and 71% use reminders. This correlates with the helpfulness ranking of these features for study planning. Of all participants, 64.7% indicated that they use calendaring software for study planning. We also found a diverse use of time management practices, involving a range of technologies and tools. However, students apply mostly short-range study planning strategies using deadlines as their primary planning source. Those students who struggle with deadlines or missed them in the past indicated that they use more calendaring software features and find that contemporary calendaring software lacks support for study time management. In summary, our findings show that time management for study planning is a very individual activity, and that students use a wide range of software tools, platforms, devices, and time management practices. This leads to the following issues:

1. Existing calendaring client software such as Microsoft Outlook, for example, allows for individual study planning, but typically lacks features enabling effective management of collaborative learning activities and study groups. Furthermore, they were designed with a professional workplace environment in mind. In contrast, the university learning environment is much less structured and more heterogeneous. This is also reflected by our survey results.
2. Existing groupware software or server-based calendaring software can alleviate the problem of heterogeneous client environments working together, but it is also less specific and extensible. Furthermore, new problems arise when it comes to synchronising central data with different client tools. In our survey, the need for such synchronisation features was rated essential by nearly three quarters of all participants. One example of such a central solution is Google Calendar which the majority (64.7%) of those who use any such software use for study planning.
3. To our knowledge, none of the existing software solutions addresses the specific requirements of student learning. This includes social aspects of learning, that is, communication between peers performing similar learning activities, locational aspects and social presence, when learning activities/resources are bound to a geographical location or when peers are available in the area, and finally motivational aspects.

The aim of this study is to address the above issues. Our approach is based on the combination of several techniques, namely traditional time management using calendaring features, enhanced social presence, location awareness, and learner motivation. The idea of enhanced social presence was first introduced by (Eisenstadt & Dzbor 2002) as a way to motivate and sustain social interaction between geographically distributed users in an instant messaging network (BuddySpace). The status of resources available in a defined workspace is also exposed. It is claimed that enhanced presence enables spontaneous user interaction and group formation (Eisenstadt & Dzbor 2002, Eisenstadt et al. 2003) and enhances user motivation (Bai 2003). Similarly, Mochizuki et al. (2008) found that exposing the progress of students in group-based learning projects to other group members enhances their "sense of learning community" and hence their motivation. Furthermore, we believe that such information is very helpful for personal time management as it can serve as an indicator for personal compared to group progress. For example, students can assess whether they are behind or ahead of schedule based on other people's progress. Finally, Holme & Sharples (2002) and later Corlett et al. (2004) combined time management, course material, communication, and concept-mapping tools in a mobile student learning organiser software. They found that, despite of some usability issues (Corlett et al. 2005), timetabling and communication tools were used significantly. Apart from this related work, there has been little research on technology-enhanced student time management.

2 Prototype Design

Based on the results of our survey and the related work, we designed a new time management system. We decided in favour of a web-based system because 76% of all survey participants indicated that they own and carry a web-enabled mobile device on campus, and all students have easy access to network PCs across the campus or at home. Then, we developed a list of desired features and requirements based on how helpful students expected them to be for time management. These are

1. Synchronisation of tasks and events with mobile devices
2. Scheduling of meetings with supervisors and study/assignment group members

3. Division of work in group assignments and observation of task progress within and across groups
4. Estimation of time on task and critical task warnings
5. Enhanced presence: locating friends on a virtual campus map
6. Finding experts based on interests and/or past task achievements
7. Location-based reminders
8. Management, sharing, geo-location, and rating of on-line learning resources

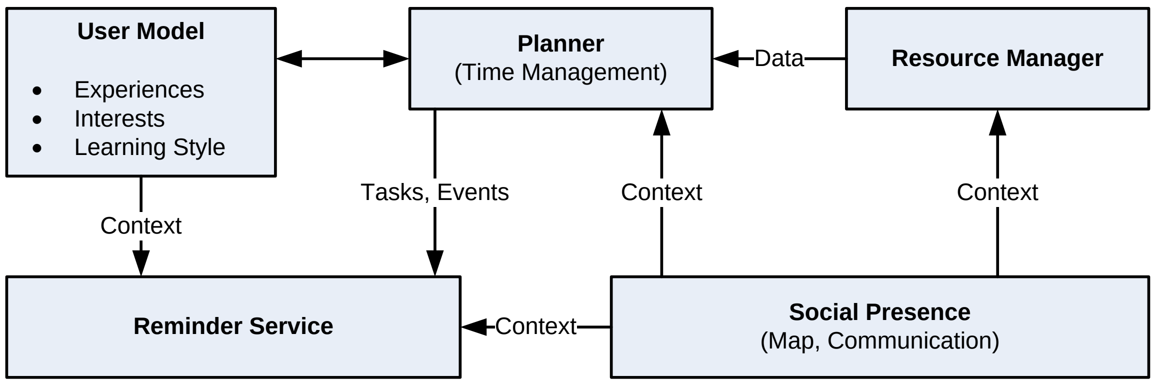


Figure 1: Prototype architecture

For the first version of the prototype, we concentrated on high-impact features, in other words, we did not implement all of the above use cases. More specifically, we implemented social presence features (map, communication features, etc.) and the planner. Consequently, the current version still lacks time-on-task estimation support, adaptation to learning style, expert search, resource management, and reminder features.

The prototype architecture is shown in Figure 1. Its main component is the planner. It takes user-generated tasks and events to create a to-do list or calendar which is presented to the user in various formats. A task is defined as a 7-tuple $T = (t_d, d_p, d_a, p, s, L, C)$ where t_d denotes the due date and time, d_p the planned task duration in hours, s the task state, L the task location (optional), C a set of task characteristics, d_a the actual task duration, and p the percentage of completion. The latter two elements are expected to be updated by the user in regular intervals and constitute their individual task progress. The task state s is one element out of {red, yellow, green} indicating whether the task is critical (red) or uncritical (yellow, green). Figure 4 shows an example of a list of colour-coded tasks. Similarly, an event is defined as $E = (t_s, t_e, L)$ with t_s being the start and t_e the end date and time, and L being an optional event location. Recurring tasks are also supported. A location $L = (g_{\text{lat}}, g_{\text{lon}})$ is a combination of a geographical latitude g_{lat} and longitude g_{lon}. Tasks can be nested in a hierarchy and be dependent on the completion of a set of other task. A task which contains sub-tasks is complete if all sub-tasks are complete, in other words, p and d_a of such tasks are the average of p and the sum of d_a of all sub-tasks, respectively. The planner is context-aware, so that it receives user characteristics from the user model and geographical context data from the social presence component. Furthermore, resources can be attached to tasks. The output of the planner is a set of tasks and events. Users can indicate what tasks they are currently working on (see Figure 3); the system will then show who else is working on the same group tasks and show these users on the virtual map (see Figure 2a).

The reminder service uses the output of the planner in order to issue context-related reminders. For this purpose, it also makes use of user characteristics and the user's social presence state.

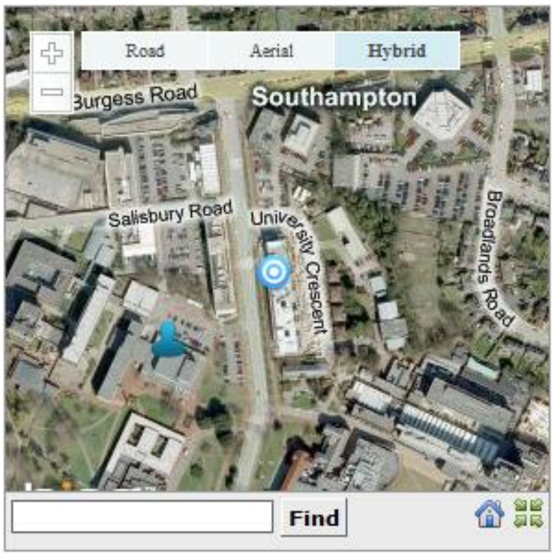
The social presence is realised as a virtual map displaying all location-bound tasks and events and other users associated with the current user. We use Microsoft Bing maps[1] in combination with Skyhook Wireless Loki API[2] for this purpose (see Figure 2a). The latter API allows the detection of the user's current geographical location based on wireless hotspots in the area. Since this method is not always 100% accurate and requires a WiFi adaptor to be installed on the device, users can set their position manually on the map. Furthermore, an instant messenger (the on-line version of Microsoft Live Messenger) is provided and asynchronous text messages can be exchanged between users. The latter feature is conversation-based, that is, every message starts a new conversation between sender and recipient(s). Subsequent replies to a message are attached to the open conversation.

[1] http://www.bing.com/maps/
[2] http://www.loki.com

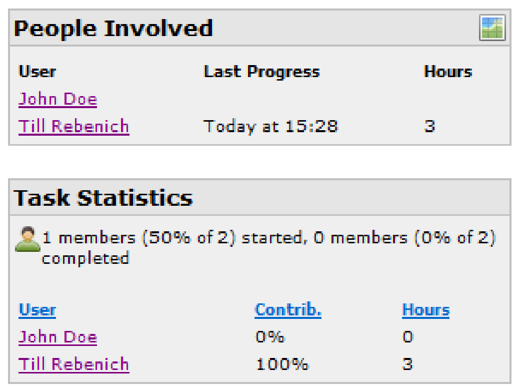
In our system, we use a group-based design. As with tasks, groups can be nested hierarchically. Each organisational unit such as the school, the module, etc. is represented as a public group. These groups can be joined by all users without restrictions. Conversely, students can create private groups such as study groups, for instance, within public groups. Membership in private groups must be approved by the group manager, that is, the user who created the group. All tasks are created in either group or user context. Group tasks are further divided into individual group tasks and collaborative tasks, whereby the former denotes tasks which must be performed individually by each group member, and the latter tasks which require all group members or any sub-set of them to collaborate. Progress made on group tasks is published to all group members (see Figure 2b). This is not the case for private tasks, which are only visible to the user who created them.

Tasks and events in the system can be exported to Google Calendar. This enables users to synchronise such data with any device they own. Google provides synchronisation tools for a wide range of device types and platforms.

Our prototype was implemented as a password protected on-line platform by using ASP.NET on the latest .NET Framework 3.5 and hosted on a Windows Server 2008 Enterprise Edition. As a data store, we used Microsoft SQL Server 2008.



(a) Social presence on a virtual map (own position and that of another user is shown)



(b) Task statistics showing progress of other users in the same group

Figure 2: Social presence and task statistics

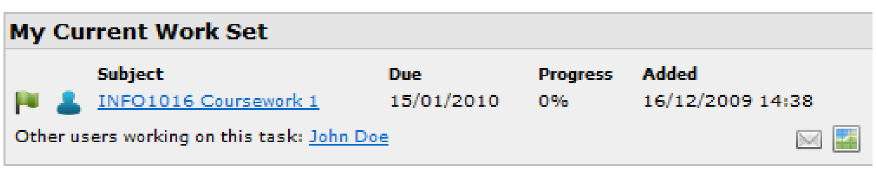


Figure 3: List of tasks a user is currently working on and associated users working on the same tasks

3 Evaluation and Future Work

Our research objectives are to evaluate the effect of the prototype described in the previous section on students' academic performance, coursework hand-in statistics, motivation, stress, and learning experience. Furthermore, we will be monitoring system use over time in order to detect changes in user behaviour, that is, to evaluate whether the system can help students develop their personal time management skills. Finally, the claims of Eisenstadt & Dzbor (2002) regarding user interaction and group formation and our own claims made in previous work (Rebenich & Gravell 2008) need to be tested.

3.1 Experiment Design

We chose a two-condition repeated-measures experiment design with two first-year undergraduate courses in our department (ECS). The first is the computer science course “Programming Principles”, and the second the information technology in organisations course “Information Technology and Systems”. Since our study is intrusive, we had to seek ethics committee approval first and students had to sign up for the trial. Participation is completely voluntary, students are free to spend as much time as they want working with the system, and no inducement is used. The distribution of participants in each course and their division into trial and control groups are shown in Table 1. The group allocation was done completely randomly. However, based on the findings of Macan (1990), who reported evidence that women are better time managers than men, and because we did not want to bias our experiment, we ensured that the proportion of females in each experimental group equals the proportion of females in the total number of participants in each course. We note that the relationship between gender and time management skills is seen somewhat controversially: Trueman & Hartley (1996), for example, did not find any such correlation.

Course	Students Enrolled	Trial Participants	Male	Female	Trial Group	Control Group
Programming Principles	95	49 (51.5%)	42 (85.7%)	7 (14.3%)	24	25
IT and Systems	31	16 (51.6%)	11 (68.8%)	5 (31.2%)	8	8

Table 1: Experiment participants

The experiment started in the second week of semester one in 2009 and runs until the end of semester two in 2010. In the first semester, the trial group uses the prototype software while the control group does not, and in the second semester groups are swapped, that is, the control group becomes the trial group and vice versa. By doing so, we give both groups the opportunity to potentially benefit from the software, and we can collect more data over a longer period of time. At the beginning of the experiment, students were invited to participate in a kick-off session introducing the basic system functionality. Members of the trial groups also received their personal log-in data via email. During the trial, we take the following measurements:

- System log data: We log all student activity in the prototype system for behavioural analysis.
- Performance data: For each participant, we access hand-in statistics and course marks.
- Questionnaire data: Students will be asked to fill in short on-line questionnaires from time to time. These are embedded in the prototype system. Questions will be about motivational state, learning style, and subjective feedback about our prototype system. We decided in favour of the learning style model of (Felder & Silverman 1988), more specifically, the Index of Learning Styles (ILS) presented in (Soloman & Felder 2001).

The outcome of these measurements will be analysed anonymously, and several follow-up experiments with more experienced students (second or third year) or Master and PhD students are planned. Their design is dependent on the results of the first experiment.

3.2 Discussion

We presented the design of a group-based, location-aware, on-line time management system prototype and an experiment we are currently carrying out in our department. Our approach is aimed at combining enhanced social presence (Eisenstadt & Dzbor 2002) with location awareness and motivational techniques used in project-based learning (Mochizuki et al. 2008), thereby delivering a time management system addressing the special requirements of learning at university level. Rather than forcing students to apply a particular time management strategy, we merely provide them with a set of tools which they can use in their personal time management. This approach seems sensible in view of our previous survey whose results show that individuals use a wide range of different strategies and tools based on their personal needs and experiences.

There are several factors which are important for the success of our trial. Firstly, the helpfulness of features concerned with enhanced social presence and progress data disclosure is dependent on as many students as possible using the system on a regular basis. Albeit around 52% of each course signed up for the trial, we needed to split the participants into trial and control groups, thereby further reducing the number of system users. This could be detrimental to the number of interactions and thus the overall usefulness of the system. Based on the results of the first trial, which we expect to be available in the first half of 2010, we will have the opportunity to reconsider our experimental design.

Secondly, the allocation of participants to each experimental group was performed randomly. While this procedure ensures the groups are unbiased, it also neglects existing relationships between students in the target population. For example, it might lead to members of a group of companions being separated, making some group-based features such as study group organisation, for example, irrelevant to the group.

Thirdly and finally, our experiment is conducted with first-year students. There is evidence (Trueman & Hartley 1996) that time management skills increase with age. Since our system does not enforce a particular time management strategy, participants might be missing a certain degree of guidance or tutoring. Eventually, this could result in them becoming passive participants, which would then affect the overall system effectivity.

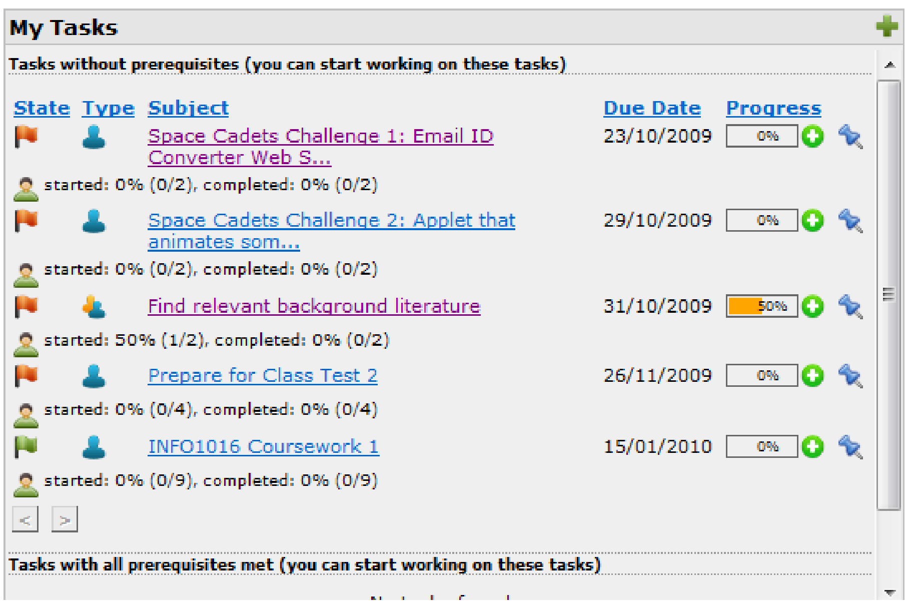


Figure 4: Colour-coded task list with individual progress and group statistics

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