Encouraging an Active Lifestyle with Personal Mobile Devices: Motivational Tools and Techniques

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ABSTRACT

Encouraging physical activity amongst different groups, age ranges and cultures can be a difficult task. As such research has been undertaken in order to find methods of allowing people to monitor their own activity levels and hence allow them to alter their lifestyle in such a way as they become more active. It is possible to achieve this aim through a number of methods, ranging for individual personal devices to making use of social groups and social feedback in order to further encourage physical activity through the notion that friends can also monitor our progress. In this review paper we look at some of the work undertaken in understanding the desire of those who wish to become more active, paying particular attention to those with sedentary lifestyles. We also take a look at the technologies and methods utilised to aid and motivate these people in achieving their goals.

Categories and Subject Descriptors

H.5.2 [**User Interfaces**]: User-centred design, Input/Output de- vices, Strategies, Hardware technologies, Interaction Styles

General Terms

Design, Human Factors

Keywords

Mobile learning, User experiences, Nudge, Social norms

1. INTRODUCTION

Motivating and encouraging physical activity can be a challenging feat. At one time or another many of us are struck with the desire to join the local gym, go for a run or tackle the latest fad diet. The difficulty comes in keeping up the commitment to pursue the goal we initially set out to achieve. Within a few weeks the motivation to go to the gym can wain and that run we promised to go on can be put off because we know that we will *definitely* go tomorrow. For those of us with sedentary jobs these goals can be even more of a struggle. As such, research has been ongoing in creating a design methodology and technologies with the purpose of encouraging and maintaining an active lifestyle.

This paper gives an overview of some key literature relating to the subject of encouraging an active lifestyle and gives mention to how this aim was carried out by the respective authors and the results that they achieved. We then outline some design guidelines for mobile based motivational activity monitoring applications that we hope to apply in our own future work.

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2. RELATED WORK

In this section we will discuss various technologies and areas of research relating to the study of encouraging a more active lifestyle. We have categorised the topics into three sections and describe the relevant topics within those sections.

2.1 Personal Activity Monitoring Devices

With people's will to become more active and healthy there is no surprise that there has been a great deal of personal portable devices released in order to allow people to more accurately monitor and maintain their own levels of fitness. The most common form of these devices is the pedometer, a simple, small and unobtrusive device which monitors the wearer's step count. These devices are usually attached at the hip and the most basic use mechanical parts that move when the wearer walks and thus registers a step count. Research has shown that the physical presence alone of the pedometer (screen is off) can increase the activity level in adults [5].

However these devices can be more complex and allow for more information than just the step count to be displayed. One example is the PAM system[1] which, like a normal pedometer is worn on the hip and measures the wearers activity level. The PAM makes use of an accelerometer in built in the system which monitors all the movements of the wearer and displays the activity level as a PAM score. This score can be viewed on the accompanying website, which allows the user to monitor their progress and set goals such as weight loss and find what their average score is. Slootmaker et al.[16] found that the PAM was a useful and accurate tool for both monitoring and encouraging an active lifestyle.

The fitbit system[2] is another unobtrusive activity monitoring system that can be worn discreetly by the user and is used to monitor both activity levels and sleep patterns. The system wirelessly communicates with a base station in the home which in turn uploads the activity progress to a website. The system monitors calories burned and steps taken and the website is used in order to set goals to aim for and to keep track of the user's activity patterns.

Obesity is seen as a rising problem in both adults and children and can lead to many other health problems such as cardiovascular disease and diabetes. Arteaga et al. [4]

[1] `http://www.pam.com/index.php?pid=3`
[2] `http://www.fitbit.com/`

argue in their paper that the key to combating obesity in adults is to target teenagers and educate them about the potential health risks of overeating and leading a non-active lifestyle, thus believing that it is better to teach the issues sooner rather than later. Targeting younger generations in order to teach them the value of leading an active lifestyle is something that's also been undertaken by large corporations. In particular Nintendo released an activity monitoring game for their DS system entitled Walk With Me[3]. This game comes bundled with two pedometer accelerometers in order to encourage more than one member of the household to take part in monitoring their levels of physical activity. The system allows the user to set a step target and is then used in much the same way as similar step counters, however, at the end of the day they can transmit the results to the DS system where they can view a detailed breakdown of their activity levels for that day. This in turn provides the user with monthly and weekly averages of their step counts and allows them to set new goals as and when they want to. Their step counts can also be used to play mini games on the system, allowing for a competitive nature within the family household. The system is even designed so it can be used with a pet dog, so that the user can also monitor their pets activity in comparison to their own. In all it is a fun system which has been designed in order to make the monitoring of physical activity levels feel less like a chore and to encourage individuals to keep going and reach the goals which they may have set.

Tesco Diets Active[4] offers an online personalised coaching programme. After enrolling to the programme, a wrist-band called miband is sent to the customer. The miband records everything the user does throughout the week, from housework to workouts and everything in between. The user can synchronise their miband on a weekly basis with the online coaching system via a Bluetooth connection. The online system allows the customer to set up weekly basis goals i.e. the distance to traverse. This is also combined with a range of tasty healthy eating plans to facilitate a full healthy lifestyle makeover.

There are also devices available to monitor and track individual's progress for those people who already lead an active life and want to maintain their own progress. The Nike Plus system, developed by Nike and Apple, allows a user's iPod to be used as a running aid which allows them to set distance goals and keep track of their progress as they train. The system allows the user to specify a goal, such as the amount of calories to burn or the distance to traverse. Also at anytime the user can press a button and receive audio information relating to their current distance, run time and pace. If they have set a goal then at key points along their route they will receive an audio prompt notifying them that them have completed some or all of their set goal.In addition the system also includes the voices of several prominent athletes who, at the end of the workout, congratulates the user if they have achieved a new personal best.This information can be uploaded to the Nike plus website which, as well as allowing you to challenge friends, gives a breakdown of user's progress and a complete history of previous workouts.

[3]http://www.nintendo.co.uk/NOE/en_GB/games/nds/walk_with_me_do_you_know_your_walking_routine_10465.html

[4]http://www.tescodiets.com/index.cfm?code=370027

2.2 Personal Activity Monitoring on Mobile Platforms

Although, personal activity monitoring devices like pedometers are practical for some people, for others it becomes another thing to remember to carry. As such there has been work examining the porting of activity monitoring applications onto mobile platforms and, in particular, mobile phones. A quick browse of either the iPhone App store or the Android marketplace at the time of writing returns many results regarding pedometer applications or activity monitoring applications. All applications give an indication of your step count by making use of the onboard accelerometers commonly found in many modern phones and some (such as CardioTrainer) also include inbuilt GPS services allowing user's to more accurately track their fitness progress and, for example, their walking routes.

An extensive body of research has been conducted regarding the subject of mobile based personal activity monitoring applications. One such system is the UbiFit system [7, 11], developed by Consolvo et al. The UbiFit system transforms the background wallpaper on a mobile phone into a garden scene. As users become more active or indulge in physical activity throughout the week the garden grows, with several different flowers representing various activities such as walking, cardio or strength training. At the end of the week the screen is wiped blank and flowers are regrown as activity is undertaken again. The system also makes use of butterflies in the garden to represent goals that have been met by the user and these butterflies remain when the rest of the garden is erased as a reminder that the user previously managed to reach their goals. The UbiFit system is not soley contained to just the phone however and does make use of an external activity monitoring device known as an MSP (Mobile Sensing Platform)[6] which has been trained to automatically recognise in real time various activities such as walking and running. The system does also have an activity diary feature so that any activities that cant be automatically inferred can still be manually entered. It is suggested, that although this system makes use of an external module that eventualy phones will include the majority of sensors required allowing for a user to simply slip their phone into their pocket at the start of the day, with no need to remember to wear an extra device, improving in cases where it may be impractical to attach a pedometer or MSP type device to the waist and making it impossible to actually forget the extra device since the phone is all you would requite.

Nokia has conducted work into how such mobile based applications should be designed. The findings of which appear in several papers by Ahtinen et al. [1, 2, 3] and discuss the design and user experiences of wellness applications. These papers study issues that need to be considered when designing for cross cultural wellness applications, the social features of such applications and also the user interface design of the applications. The research has found that offering a gaming experience, social sharing opportunities and proper feedback resulted in improved motivation from participants. This work also provides a nice framework regarding design considerations and these findings are supported by additional work by Consolvo et al. who have also provided their thoughts on design for such applications in [9, 10]. These papers also study the use of persuasive applications on mobile devices and how the design of goal-setting technologies in these systems can best be combined in order

to create a comprehensive system that will yield the best results for those wishing to pursue a more active lifestyle.

2.3 Beyond the Physical Devices

Many systems make use of activity trackers and the ability to set goals to aim for and achieve and some of these systems allow users to involve their friends in this goal setting process, sharing their own progress and comparing it to that of their friends. Friends are able to view and compare their own progress to the user's and also create group goals and begin friendly competitions. In the literature there exists work relating to the design of interactive games promoting active lifestyles and this goal setting process. In this section we discuss this work and also work regarding the power of social influence when promoting an active lifestyle.

Consolvo et al. [8] make goal-setting the subject of another of their papers which again details their UbiFit system. In this paper they argue how goal-setting in persuasive technologies could be an effective way to encourage behaviour change and in particular, people's attitudes to being physically active. From their study they found that the ability for participants to self set their own goals was preferred and that goal timeframes set throughout a calendar week was most beneficial to the users, especially if they could choose when the week started.

The importance and competence of self-setting physical activity goals is examined in Saini and Lacroix [15]. In this paper the authors examined how people would set their own personal goals and in turn how these goals were achieved, alongside examining how committed the participants were in achieving their own self assigned goals. This paper differs from the findings of Consolvo et al. in that the authors found that often goals were not achieved since the participants were often too ambitious in the self-assigning of their goals. They also discussed how they found that participants would, in general, often create goals which showed their intentions but didn't accurately reflect their ability to accomplish them. However they argue that goal setting in general was quite well followed and that it is likely a very important factor in motivational behaviour change with regards to encouraging physical activity. It is suggested that the over ambitiousness of participants likely stems from their novice experience with monitoring their own physical activity levels and their initial beginner experience regarding setting goals and changing their lifestyles.

In a previous paper, Lacroix et al. [12] received similar results when they examined the relationship between goal difficulty and performance of their participants. In this paper they discovered that previously in-active participants improved their activity levels by setting goals for themselves. It was also found, however, that participants who already had an active lifestyle did not increase their own activity levels to the same degree as the beginners. This is generally to be expected though, since those with an active lifestyle are likely already doing what they can to maintain it. These papers do support the findings of the papers we have discussed in previous sections though, as they show how there is still a willingness in the participants to at least attempt to accomplish the goals that they set.

Arteaga et al. [4] target teenagers in their study and created a mobile phone based game which suggests different games that can be played based on the users personality. The system consists of games based in the real world, such as searching for treasure shown on screen or using the accelerometer of the phone to act out sword fighting. The system also made use of motivational agents - two avatar figures of a man and women, who would recite motivational phrases to the player based on their personality. The male figure was more assertive whereas the female was more encouraging offering supportive comments to motivate the user to keep playing the games. Their main aim is in attempting to positively reinforce the feelings and experience of playing the game and hence keeping fit, with the memories of the fun and positive feelings the system attempts to create.

Fish'n'steps, developed by Lin et al. [13] is a game of sorts whereby participants manually submit the amount of steps they have walked each day to a team of researchers. These researchers then use this information to update an avatar of a fish, which is used to represent the activity level of the participant. In order to convey the activity level the researchers made use of emotion and size as a simple way of conveying the activity, with the fish getting bigger and happier based on greater amounts of activity, and sadder and smaller based on less activity. Some participants were also randomly assigned to a group where they could see a fish based on the overall group activity and the results in turn were used to investigate social influence and pressure to keep active. Lin et al. found that the game did indeed increase peoples awareness of their own activity levels and educated the participants so that when the study ceased the game was no longer needed as the participants had a concrete understanding of their own activity levels.

Ahtinen et al. also tackle the issue of social influence in [2]. Ahtinen et al. examine in this work how to design social features and they detail a study in India which examined the design of wellness applications and the social interaction between people. The study found that role models, family and other people striving for the same results as the participants was a good motivational social tool that helped the users to better achieve their aims.

Another system that makes good use of social encouragement is detailed in Mueller [14]. The Jogging the Distance system is targeted at runners. In particular it is targeted at people who like to run together but due to broad geographical differences in location often find it infeasible to meet in person. As such the system makes use of GPS technology and 3D sound in order to simulate to one user the respective position of the other. This is used as a motivational tool in order to provide support to individual runners and encourage them to keep going since their friend is still running and offering words of support.

3. DESIGN GUIDELINES

From the papers that have been discussed it is possible to outline design guidelines for mobile based motivational activity monitoring applications. For example much of the discussed literature agrees that social influence and the ability to set and aim for goals can be extremely helpful in encouraging participants to strive for the more active lifestyle that they desire. As such it is possible to outline the features such a system could make use of:

1. Goal Setting - In [8, 15, 12] goal setting was found to be of great use and a key component in motivating the user's of their systems in keeping active. It would be beneficial therefore to include some form of goal setting and reward system for users in mobile based systems as a way of motivating users to use the system and to track their progress.

2. Social features - The ability for users to share their progress to other users of the system is also a powerful motivational factor. Allowing participants to view their progress alongside that of their friends or other users in their group showed in [2, 14], that it helped to encourage that user to be more active themselves. The loyalty to a group or the knowledge that others will know when you have not been as active or met your own goals could be very motivational, also the ability to invite friends could help to provide a feeling of comfort and camaraderie as in the Jogging the Distance system and would be a powerful addition to a mobile based activity monitoring application.
3. Feedback - In all the literature the way feedback is presented is an important factor. We believe It is important to allow users to track and monitor their progress and to also be able to compare their progress with that of other people. As such it would be beneficial to allow the users to access a system that provided a breakdown of their activity patterns so they can see them changing over time. In addition consideration is needed regarding the use of a subtle or a direct reward feature based on the user's progress.
4. Reminders - The benefit of consolidating the pedometer functionality onto a mobile device loses the reminder an external device subtly gives the user and so it is possible that users may become less aware or less motivated as time goes on since they forget the system is running on their phone. A solution is to provide regular reminders much like the subtle wallpaper reminder included in the UbiFit system or similar so that the users are continuously aware that there activity is being monitored.

4. CONCLUSION AND FUTURE WORK

In this paper we have discussed previous work relating to the study of promoting physical activity. We have discussed the benefits of existing products such as pedometers, the Nike Plus system and the PAM and discussed how these systems can be applied to mobile platforms. We have also discussed work relating to the more encompassing issues of promoting an active lifestyle, such as how to keep people interested and motivated in achieving their goals and how goal setting and social influence are possible ways of doing this. As such, the discussed literature allows us to construct guidelines which will aid us in designing a unique mobile activity monitoring application that will motivate people in pursuing a more active lifestyle. In addition the application will aid users in increasing their knowledge of their own physical activity levels as well as those of others, resulting in them adapting their lifestyle habits accordingly.

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