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Exercise in the Smart Workplace

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Abstract. Employees that engage in even moderate amounts of exercise during their working day suffer less from stress and are more tolerant in the various irritations that accompany normal working life. Though it cannot be said with certainty that such workers are more productive, tentative evidence suggest that this may well be the case. A useful service of a smart office or work environment is to contribute to the health and well-being of those that inhabit such spaces. One practical approach to this is to monitor the exercise that employees engage in during the day, and using this as a basis, motivate them to engage in further physical activity. In this paper, issues relating to monitoring employee physical activity are explored.

Keywords. Pervasive health, Exercise,

1. Introduction

A key objective for smart environments is to contribute to the well-being of those that inhabit them. This may include aiding them in the fulfilment of their tasks, acting in anticipatory manner and so on. One useful service that could be supplied by a smart environment concerns the monitoring of user's physical activities, and relating these to exercise or energy expended. Such feedback could usefully inform employee's fitness regimes. Even more intriguingly, employees could be proactively encouraged to do more exercise during the course of their everyday work.

A question that naturally arises is why employers would want to encourage their employees to be doing more physical exercises during company time. It has been suggested that promoting exercise leads to more productive workers and contributes to corporate social responsibility [1]. In the former case, the evidence is somewhat contradictory. For example, physical activity has been demonstrated to have a positive effect on coping skills and toleration of minor irritations [2] [3]. However, in a systematic investigation into the link between physical activities programmes and workplace productivity, Proper at al [4] found no correlation. Other studies, for example Hildebrand et al [5], while drawing no definite conclusion, do nonetheless suspect that mood and attitude might be improved though physical activity.

For the general population, it has been long known that a positive relationship exist between daily physical activities and aerobic exercise, at least for adults but not for children [6]. Physically active people have lower incidences of mortality from practically all diseases and suffer less from mental health problems [7]. However, a key problem for many health and physical fitness experts is obtaining reliable data concerning the amount of physical exercise that adults actually take. There is evidence that suggests that people tend to exaggerate the amount of physical activity that they do and underplay their sedentary behaviours [8]. Clearly, an unequivocal method of gathering such data would be most beneficial. How this might be achieved is considered next.

2. Quantifying Physical Activity

A popular approach to estimating the amount of exercise or indeed other habitual activities is to ask the person in question to complete a questionnaire. This can be error prone for a number of reasons. People can forget, or as described previously, they may actually over-estimate the amount of exercise undertaken. One pioneering study in in-situ self-reporting was carried out by Klasnja et al [9]. Their findings suggest that a

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sampling frequency of between five and eight times day may yield the optimum balance between recall and annoyance. Such reporting should take place at regular and predetermined times. The device used for this study was the Mobile Sensing Platform [10]. This platform was used to establish the ground-truth and self-report data was collected using a mobile device.

Rather than explicitly interrupting the person to ask them what they have been doing, a second approach is to passively monitor their activities and derive exercise models from that. Two approaches may be adopted. In the first case, the employee wears the necessary monitoring equipment about their person. In the second case, the user is tracked by a sensor infrastructure in their work environment and their exercise activity calculated.

2.1. A Wearable Approach

In this case, employees would wear a suite of physical sensors on their very person, the Mobile Sensor Platform discussed previously being one example. A mobile phone should also be carried. Capturing the data on the phone and interpreting it would not pose major difficulties. However, the devices should be carried around at all times - a situation that is not desirable as people will invariable forget and leave the devices on their desks. Indeed, there is evidence that suggests that people do not carry their mobile phones as much as would be expected [11].

A more interesting approach is to embed the necessary sensors into a persons clothing. This scenario is promising in that people would wear a sensor-augmented garment and go about their business in the normal way. When in the proximity of a base station, a record of the physiological data would be uploaded for interpretation. This approach is under investigation in our laboratory and initial results are promising. One practical limitation is that garments with embedded sensors are not commonly available as yet and only available in certain domains, for example, physiotherapy and sports science. However, it is a realistic expectation that this situation will change over time. A key advantage of this approach is that the person's activity can be monitored at all times, in both indoor and outdoor environments, leading to far more accurate measurements on which appropriate courses of action can be identified.

2.2. A Smart Environment Approach

A diametrically opposite approach to that just described is for the environment itself to monitor the physical activity of those people working within it. In itself, this is not a radical concept as the monitoring of such activities has long been perceived as a basis for service provision in smart environments [12] [13]. Such an approach would free the employee from the obligation to carry their phone at all times or to acquire and wear certain garments that they may not be comfortable with. In practice, the approach would be limited in that once people roam outside the scope of the smart environment; their physical activities could not be measured. A further complication that would be prominent in this situation would be the ubiquitous issue of privacy.

A number of approaches could be adopted for tracking user movement and calculated their energy expenditure. A dedicated network of sensors, for example Ubisense [14] could be deployed. This would be comprehensive but expensive. It would also demand that the employee carries their tag at all times. Given that approximate records of user activity should be adequate, such a system would be overkill. A second approach might be to place appropriate tag readers at key points in the work place. A network of RFID readers would not be expensive to deploy but employees should wear their tags at all times. A variation of this approach might be to use pre-existing infrastructure. For example, a network of swipe card readers might be deployed, and this could be harnessed to construct movement models. Likewise, if a network of CCTV cameras has been deployed, it may be possible to harness these.

A prerequisite to quantifying exercise activity in a smart environment is the availability of a scaled model of that environment. In practically all cases, a CAD drawing can be used as a basis for this environmental model. Should the environment have an outdoor component, a geocoded model of sensor locations or sensor readers would be required.

3. Conclusion

Significant effort and expense can be incurred when deploying the technology necessary for a smart environment. Such environments may be used in diverse ways and this paper explored one possibility in the pervasive health domain. Contributing to the physical and mental health of employees offers a number of benefits including improved employee performance as well as the numerous benefits that accrue to families and society. This paper explored how smart environments can be harnessed to monitor the physical activities of employees. By quantifying how much physical activity is engaged in during the day, appropriate intervention strategies can be identified and implemented to motivate further exercise in the course of everyday work-related activities.

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