Designing Copresent Cycling Experience

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Abstract. There has been much UbiComp research into motivating people to live more active and healthy lifestyle with sports. The idea behind these approaches is centered on social and peer effects in enhancing exercise adherence. While research of this kind has been prolific, there has very little work been done to identify factors that embody comfortable and informed accompanied exercise experience. This paper takes an increasingly attractive cycling theme as a testbed and proposes an unobtrusive and intuitive interface arrangement based on light. It can create a sense of being together with each other for distant apart cyclists. The initial results yield a good level of comprehension and motivation towards the use of the interface. The hope is that the elicited recommendations can guide the design of UbiComp technologies for social motivational physical exercises.

1 Introduction

The increment in habitual physical inactivity has brought multidisciplinary domain experts together including behavioral, social, mechanical, and computer scientists to confront this via their consensus of motivating people to discard sedentary lifestyle [1][2][3][4][5][6][7]. Specifically, this paper looks for answering the question: How we should take steps to encourage personal exercise through technology.

Nowadays, mechanical and computer technologies have jointly shown their popularity to provide people with variety of controlled exercises within stationary settings. Jogging on a treadmill and riding on an exercise bike are the most common forms of synergy between the two. The measurement and support of attuned exercises can simply be done by the relevant sensing and reasoning technologies. The estimated level of fitness is then delivered, perceived, and experienced mainly through the computerized console. There are also liberal research attempts on the advantages of social-enhanced applications for physical exercises [8][9][10]. The implementations mostly focus on the techniques of tracing and sharing progress of physical activities. However, guided directions to the embodiment of how the motivation is set up in terms of the interface design are surprisingly limited.

This paper aims to elicit the design recommendations for interfaces that can create a sense of mutual awareness for distant physical exercisers. Specifically, this research investigates the possibilities of using light to peripherally convey workout information, which notifies personal and partner's physical status, while doing exercises in the real scene. Although a number of exercises could act as a potential testbed to better understand the insight on designing interface of this kind, cycling is selected not only due to its nature to health and environment but the appreciation and its increasing popularity as a means of exercise [11][12][13][14]. In order to look into the implications of designing the interface in context, a prototype for case study has been developed based on the concept of user-centered design. The focus is on discovering the parameters, which the interface is made of, along with the manner of how a medium for communication within exercise settings is chosen and positioned.

The following pages expand this by presenting the design and implementation of the prototype. The second half of the paper describes the user studies in an attempt to identify the perception, comprehension, and experience of the interface usage. The closing sections then focuses on eliciting recommendations for the design of the interface for social motivational physical exercises.

2 Design of the Prototype

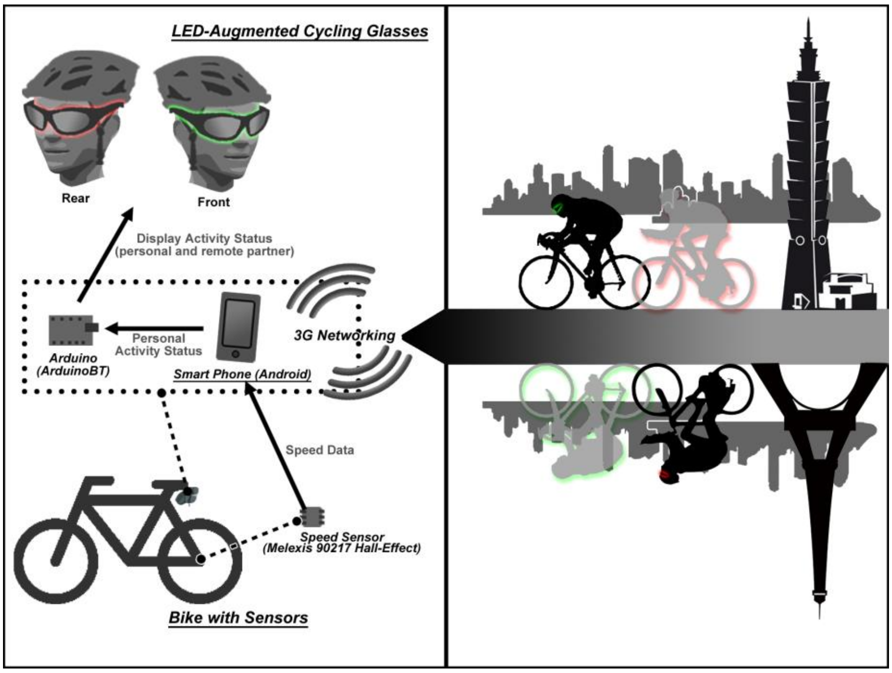

Fig. 1. Prototype schematic diagram

The aim of this design is to create a sense of cycling together via bridging the physical distance between cyclists without explicitly demanding much of their attention. The target scenario in this paper is a two-person cycling activity. This specific case was selected in an attempt to echo the atmosphere of busy lives these days. Hard to find mutually convenient time and place to do exercise with partner is the common cause that hinders turning exercise into habit. The initiative herein is to identify what information can be tracked and how it is shared to form the sense of cycling with a companion. As can be seen from most of the recent exercise bikes in the market, the information they provide is about level of personal activity, which comprises speed, distance, heart rate, calories burned, and etc. Also, as noted by social comparison theory, humans have an instinct to gauge the self through contrasting themselves with those contextually relevant others [15][16]. It is, therefore, synchronously sharing the activity information between cyclists could create a sense of copresence and motivate them to be more active towards the exercise [17].

The progress in mobility with a range of sensors and actuators has provided the possibility to move from immobile to ubiquitous exercise experiences. However, the challenge facing is how technology should act to enhance which sensory abilities in order to implicitly restore a sense of copresence as in locomotion and exercise. The emphasis at this stage is on the selection of an appropriate medium to convey the activity information via augmented existing sport equipments. Ishii et al. argued that a more engaged personal experience could be realized by virtue of allying the metaphor of artifacts with the way they prompt human senses [18][19][20]. Cycling helmet and glasses are the most common wearable accessories for safety purposes. They share the metaphor of cover and protection. The glasses, however, has yet another symbolic meaning of assistive viewing. Colored and prescription lenses allow cyclists with different level of eyesight to adopt to see properly in various weather and lighting condition. To elaborate the metaphor further, the glasses could have lenses, which can allow seeing and feeling the remote cycling partner in an ambient manner. It is, therefore, use of light as the stimulus to increase the expressiveness of a cycling glasses has its inherent nature of sensory mapping.

The prototype utilizes variables of light, such as color, intensity, and frequency of flashing to deliver a general overview of the personal activity and the progress of the distant cycling partner. More importantly, the prototype intends to act and present in the light of intuitive and unobtrusive fashion, thus keeping the augmentation of the glasses as simple as possible is the key to this approach [21][22]. To go along with the idea of simplicity, there is a need to filter out the least data from the personal activity information. Speed is conceivably the core among the information. The rest of the data can be implicitly derived from it based on the idea that the higher the speed and time, the greater the heart rate and calories burned [23].

The mapping between the data and the light is as follows: The speed data corresponds to the intensity of light while the difference in riding distance determines to the color of light. When the cyclist exerts more effort into their speed, the brighter is the light [24]. Green and red indicate the relative position, in front or behind, to each other. In addition, the flash of light notifies approaching of the distance in between. To keep pace staying or placing a light competition with their partner, in either case, correlates to the aim of the design. The prototype is made of a Hall-effect wheel speed sensor, an ArduinoBT microcontroller[1], a cycling glasses with two LED built-in temples, and an Android-based mobile phone. The placement of each part is shown in figure 1.

3 Testing

A two-phase, in-lab and in-field, user study with 12 participants (postgraduates and undergraduates in both phases, 6 females, 6 males, M = 22.75 years, SD = 1.48) was conducted to see whether the design of the interface can be accurately and unobtrusively perceived. Three among the participants exercise regularly at least four times per week. The rest all expressed positively to the idea of exercise as a health behavior and go with it on friends-invitation basis. Prior to beginning of the in-lab study, a brief instruction regarding the information coding was given. The result indicates 92% of the participants can accurately identify the personal and remote

[1] ArduinoBT: http://arduino.cc/en/Guide/ArduinoBT

partner's activity level. However, one female participant argued that the change in frequency of flash has more apparent implications on speed.

In the second phase, the participants were randomly paired. They all geared up as shown in figure 1 and took a 5km test ride in a riverside park on different bikeways. After completing the ride, all the participants gathered and rested up in a cafe and were asked to verbally express their perceived level of personal activity. During the discussion, they all reported the increase in their activity level and considered that it is mainly due to the more aware of their personal activity as well as the comparison with remote partner's provided by the interface. Also, none of them felt distracted while riding. One pair of participants, a relatively active in doing exercise and a mild one, said that it started like a subtle competition, then in a matter of about ten minutes, it became more like a group ride. The more exercise-experienced peer naturally took the lead in terms of riding speed and so as distance. The other peer, at first, attempted to attack off the front and later figure out the different physical ability in between, then slow down to their moderate pace. At this point, the experienced peer also lowered their speed in order for the other peer to catch up.

4 Recommendations and Conclusion

This paper contributes towards a better comprehension of the copresence interface design for cycling. The hope is that the recommendations presented could help designers who are interested in this trend have a guided experience of placing technologies to create a motivational illusion for physical exercises. The recommendations are as follows: (1) identifying personal physical activity information and the way it is delivered; (2) selecting and augmenting already-in-use accessories with relevant display media; (3) applying intuitive information encoding semantics. Hence, applications with an interface designed following the recommendations can be more assistive in motivating their users to exercise.

This research is in its early stages. The initial results that have raised a host of further questions:

- Will increased feelings of presence increase motivation in the long term so that the health and fitness goals will be achieved?
- Can the feedback be used to sustain the sense of presence in the longer term and will users find ways to appropriate the feedback mechanisms in ways that the designers never intended?
- Will the use of these complementary feedback mechanisms increase the feeling of presence without increasing the risks through distraction and ideally reducing the risks of cycling in large groups on busy roads?

The next stage will involve thorough usability evaluation of the prototype base on the above questions to see the influence on the cycling experience.

References

1. Barkhuus, L.: Designing ubiquitous computing technologies to motivate fitness and health. In: Grace Hopper Celebration of Women in Computing. (2006)
2. Froehlich, J., Dillahunt, T., Klasnja, P., Mankoff, J., Consolvo, S., Harrison, B., Landay, J.A.: UbiGreen: investigating a mobile tool for tracking and supporting green transportation habits. In: Proceedings of the 27th international conference on Human factors in computing systems, pp. 1043-1052. ACM, (2009)
3. Purpura, S., Schwanda, V., Williams, K., Stubler, W., Sengers, P.: Fit4life: the design of a persuasive technology promoting healthy behavior and ideal weight. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 423-432. ACM, Vancouver, BC, Canada (2011)
4. Abowd, G.D.: What next, ubicomp?: celebrating an intellectual disappearing act. Proceedings of the 2012 ACM Conference on Ubiquitous Computing, pp. 31-40. ACM, Pittsburgh, Pennsylvania (2012)
5. Boks, C.: Design for Sustainable Behaviour Research Challenges. In: Matsumoto, M., Umeda, Y., Masui, K., Fukushige, S. (eds.) Design for Innovative Value Towards a Sustainable Society, pp. 328-333. Springer Netherlands (2012)
6. Chang, T.-R., Kaasinen, E., Kaipainen, K.: What influences users' decisions to take apps into use?: a framework for evaluating persuasive and engaging design in mobile Apps for well-being. Proceedings of the 11th International Conference on Mobile and Ubiquitous Multimedia, pp. 1-10. ACM, Ulm, Germany (2012)
7. Consolvo, S., Everitt, K., Smith, I., Landay, J.A.: Design requirements for technologies that encourage physical activity. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 457-466. ACM, Montréal, Québec, Canada (2006)
8. O'Brien, S., Mueller, F.F.: Jogging the distance. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 523-526. ACM, San Jose, California, USA (2007)
9. Priedhorsky, R., Jordan, B., Terveen, L.: How a personalized geowiki can help bicyclists share information more effectively. In: Proceedings of the 2007 international symposium on Wikis, pp. 93-98. ACM, (2007)
10. Babu, S., Grechkin, T., Chihak, B., Ziemer, C., Kearney, J., Cremer, J., Plumert, J.: A Virtual Peer for Investigating Social Influences on Children's Bicycling. In: Virtual Reality Conference, 2009. VR 2009. IEEE, pp. 91-98. (2009)
11. Eisenman, S.B., Miluzzo, E., Lane, N.D., Peterson, R.A., Ahn, G.-S., Campbell, A.T.: BikeNet: A mobile sensing system for cyclist experience mapping. ACM Transactions on Sensor Networks (TOSN) 6, 6 (2009)
12. Rowland, D., Flintham, M., Oppermann, L., Marshall, J., Chamberlain, A., Koleva, B., Benford, S., Perez, C.: Ubikequitous computing: designing interactive experiences for cyclists. Proceedings of the 11th International Conference on Human-Computer Interaction with Mobile Devices and Services, pp. 1-11. ACM, Bonn, Germany (2009)
13. Outram, C., Ratti, C., Biderman, A.: The Copenhagen Wheel: An innovative electric bicycle system that harnesses the power of real-time information and crowd sourcing. In: EVER Monaco International Exhibition & Conference on Ecologic Vehicles & Renewable Energies. (2010)
14. Reddy, S., Shilton, K., Denisov, G., Cenizal, C., Estrin, D., Srivastava, M.: Biketastic: sensing and mapping for better biking. In: Proceedings of the 28th international conference on Human factors in computing systems, pp. 1817-1820. ACM, (2010)

15. Yasuda, S., Ozaki, F., Sakasai, H., Morita, S., Okude, N.: Bikeware: have a match with networked bicycle in urban space. In: ACM SIGGRAPH 2008 talks, pp. 41. ACM, (2008)
16. Thomas G. Plante, Meghan Madden, Sonia Mann, Grace Lee, Allison Hardesty, Nick Gable, Allison Terry, Kaplow, G.: Effects of Perceived Fitness Level of Exercise Partner on Intensity of Exertion. Journal of Social Sciences 6, 50-54 (2010)
17. Zhao, S.: Toward a Taxonomy of Copresence. Presence: Teleoperators and Virtual Environments 12, 445-455 (2003)
18. Chang, A., Ishii, H.: Sensorial interfaces. Proceedings of the 6th conference on Designing Interactive systems, pp. 50-59. ACM, University Park, PA, USA (2006)
19. Antle, A.N., Corness, G., Droumeva, M.: What the body knows: Exploring the benefits of embodied metaphors in hybrid physical digital environments. Interact. Comput. 21, 66-75 (2009)
20. Jelle, S., Miguel Bruns, A., Stephan, W., Stoffel, K.: How to design for transformation of behavior through interactive materiality. Proceedings of the 7th Nordic Conference on Human-Computer Interaction: Making Sense Through Design, pp. 21-30. ACM, Copenhagen, Denmark (2012)
21. Kalnikaite, V., Rogers, Y., Bird, J., Villar, N., Bachour, K., Payne, S., Todd, P.M., Schöning, J., Krüger, A., Kreitmayer, S.: How to nudge in Situ: designing lambent devices to deliver salient information in supermarkets. Proceedings of the 13th international conference on Ubiquitous computing, pp. 11-20. ACM, Beijing, China (2011)
22. Lund, A., Wiberg, M.: Ambient displays beyond conventions. In: British HCI Group Annual Conference. (2007)
23. Lee, C.-L., Lee, D., Cheng, Y.-M., Chen, L.-C., Chen, W.-C., Sandnes, F.E.: On the implications of sense of control over bicycling: design of a physical stamina-aware bike. In: Proceedings of the 22nd Conference of the Computer-Human Interaction Special Interest Group of Australia on Computer-Human Interaction, pp. 13-16. ACM, (2010)
24. Djajadiningrat, T., Geurts, L., Munniksma, P.R., Christiaansen, G., de Bont, J.: Rationalizer: an emotion mirror for online traders. Proceedings of DeSForM, Taipei 39-48 (2009)