UNIVERSITÀ DI PISA

DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

Dottorato di Ricerca in Ingegneria dell'Informazione

Doctoral Course

"Continuous monitoring of health and well-being using wearable sensors"

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Short Abstract:

The last years have witnessed a considerable growth in the market of wearable technology. Smart devices, like smartwatches and fitness trackers, embed a wide range of sensors and are potentially worn continuously throughout the day. This scenario has brought about the unprecedented opportunity to constantly monitor users' movements. In turn, this massive amount of information has led to an increasing interest in the development of applications related to health and well-being. In this context, a key challenge is represented by the reliable extraction of relevant patterns from collected signals. For instance, gait analysis applications should devise appropriate signal processing techniques to detect walking activity as well as to analyze and classify gait patterns.

In this course, students will be given a practical glimpse into the emerging field of human activity monitoring by means of wearable sensors. This will include a description of the most relevant signal processing methodologies aimed at achieving accurate and unobtrusive wearable systems.

Course Contents in brief:

- Introduction to wearable-based systems for continuous monitoring of human activities
  - Applications
  - Devices and sensors
  - System design
- Fall detection systems
  - Acceleration-based detection of potential falls
  - Pattern recognition techniques to discriminate falls from normal activities
- Gait detection and analysis
  - Lightweight and reliable detection of gait cycles using wearable systems
  - Gait pattern analysis using supervised learning or anomaly detection
    - Gait-based monitoring of medical conditions
    - Gait as a biometric feature
- Design and implementation on wearable systems with constrained resources

Total # of hours: 12

References:

[1] Lo, B. P. L., Ip, H., & Yang, G. Z. (2016). Transforming Health Care: Body Sensor Networks, Wearables, and the Internet of Things. IEEE Pulse, 7(1), 4–8.

[2] Kangas, M., Konttila, A., Lindgren, P., Winblad, I., & Jämsä, T. (2008). Comparison of low-complexity fall detection algorithms for body attached accelerometers. Gait and Posture, 28(2), 285–291.

[3] Abbate, S., Avvenuti, M., Bonatesta, F., Cola, G., Corsini, P., & Vecchio, A. (2012). A smartphone-based fall detection system. Pervasive and Mobile Computing, 8(6), 883–899.

[4] Cola, G., Vecchio, A., & Avvenuti, M. (2014). Improving the performance of fall detection systems through walk recognition. Journal of Ambient Intelligence and Humanized Computing, 5(6), 843–855.

[5] Cola, G., Avvenuti, M., Vecchio, A., Yang, G.-Z., & Lo, B. (2015). An On-Node Processing Approach for Anomaly Detection in Gait. IEEE Sensors Journal, 15(11), 6640–6649.

[6] Cola, G., Avvenuti, M., & Vecchio, A. (2017). Real-Time Identification Using Gait Pattern Analysis on a Standalone Wearable Accelerometer. The Computer Journal, 60(8), 1173–1186.

[7] Schwenk, M., Howe, C., Saleh, A., Mohler, J., Grewal, G., Armstrong, D., & Najafi, B. (2014). Frailty and technology: a systematic review of gait analysis in those with frailty. Gerontology, 60(1), 79–89.

CV of the Teacher

Guglielmo Cola is a postdoctoral research fellow with the Dipartimento di Ingegneria dell'Informazione at the University of Pisa. In 2015, he received the Ph.D. degree in Computer Engineering from the Leonardo da Vinci doctoral school (University of Pisa). He holds bachelor's and master's degrees in Computer Engineering, both received summa cum laude from the University of Pisa. During his studies, he visited for nine months the Hamlyn Centre, Imperial College London, and conducted research on gait analysis using wearable sensors. He served as member of the TPC in the PerMoby workshop and organized a special issue related to wearable-based monitoring of health and well-being (Pervasive and Ubiquitous Computing journal, Springer). His main research interests include wearable sensors, activity recognition, pervasive healthcare, and machine learning.

Room and Schedule

Room: *Aula Riunioni del Dipartimento di Ingegneria dell'Informazione*

Schedule:

- 14/05/2018: 9:30 - 13:30, **Largo Lucio Lazzarino, Piano 6**
- 15/05/2018: 9:30 - 13:30, **Via Caruso, Piano Terra**
- 16/05/2018: 9:30 - 13:30, **Via Caruso, Piano Terra**