

Extraction of Human Stepping Pattern Using Acceleration Sensors

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Abstract

Gait pattern of person characterizes individual and each condition. The precise gait pattern may be one of the measures for recognizing individuals [1][2][3][4]. Gait analysis systems using acceleration sensor were developed for medical rehabilitation [5] and identification of portable device user [6], etc. However, most systems do not catch synchronous stepping actions between right foot and left foot. In this paper, a synchronous walking sensing system is developed, where a pair of acceleration and angular velocity sensors are attached to left and right shoes of a walking person and their data are transmitted to a PC through a wireless channel. Walking data from 19 students of the age of 14 to 20 are acquired for walking analysis.

In the sensor data, x and z components of accelerations and y component of acceleration are used for analysis of walking. Stepping time diagrams are extracted from the acquired data of right and left foot actions of stepping-off and -on the ground, and the time diagrams distinguish between an ordinary person and a person injured on left leg, and a stepping recovery process of the injured person is shown Figure.1 and Figure.2. Synchronous sensing of stepping action between right foot and left foot contributes to obtain precise stepping patterns.

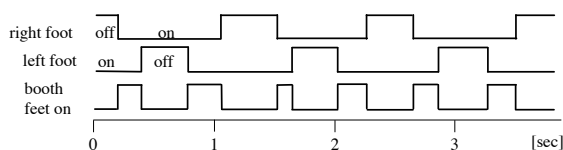


Figure.1. Stepping time diagram for the injured person.

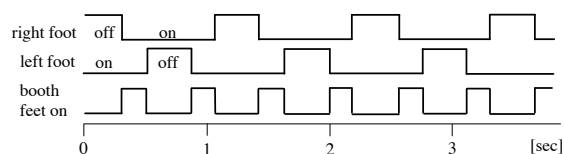


Figure.2. Stepping time diagram of 3rd experiment for the injured person.

References

1. J. Han, B. Bhanu, Individual Recognition Using Gait Energy Image, *Trans. on Pattern Analysis and Machine Intelligence*, Vol. 28, No.2, pp. 316-322 (2006).
2. Y. Makihara, R. Sagawa, Y. Mukaigawa, T. Echigo, Y. Yagi, Gait Recognition Using a View Transformation Model in the Frequency Domain, *Proc. of the 9th European Conf. on Computer Vision*, Graz, Austria, pp. 151-163 (2006).
3. K. Bashir, T. Xiang, S. Gong, Gait recognition without subject cooperation, *Pattern Recognition Letters*, Vol.31, No. 13, pp.2052-2060 (2010).
4. T. H. W. Lam, K. H. Cheung, J. N. K. Liu, Gait flow image: A silhouette-based gait representation for human identification, *Pattern Recognition*, Vol.44, pp.973-987 (2011).
5. T. Kobatyashi, Y. Miyake, Y. Wada, M. Matsubara, Kinematic Analysis System of Walking by Acceleration Sensor, *Trans. Inst. Auto. Contl. Japan*, Vol.42, No.5(2006).
6. J. Manyjarvi, M. Lindholm, E.Vildjounaite, S. Makela, H.Alisto, Identifying Users of Portable Devices from Gait Pattern with Accelerometers, *ICAPSSP'05*, March (2005).

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