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Physical Context Detection using Multi-modal Sensing using Wearable Wireless Networks

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Abstract: This paper presents the architecture of a wearable sensor network and a Hidden Markov Model (HMM) processing framework for stochastic identification of body postures and physical contexts. The key idea is to collect multi-modal sensor data from strategically placed wireless sensors over a human subject?s body segments, and to process that using HMM in order to identify the subject?s instantaneous physical context. The key contribution of the proposed multi-modal approach is a significant extension of traditional uni-modal accelerometry in which only the individual body segment movements, without their relative proximities and orientation modalities, is used for physical context identification. Through real-life experiments with body mounted sensors it is demonstrated that while the uni- modal accelerometry can be used for differentiating activity- intensive postures such as walking and running, they are not effective for identification and differentiation between low- activity postures such as sitting, standing, lying down, etc. In the proposed system, three sensor modalities namely acceleration, relative proximity and orientation are used for context identification through Hidden Markov Model (HMM) based stochastic processing. Controlled experiments using human subjects are carried out for evaluating the accuracy of the HMM- identified postures compared to a na?ve threshold based mechanism over different human subjects.