DetectAsana: Classification of Human Body Postures and Movements

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Introduction and Background

Human Activity Recognition(HAR) is an emerging field of research due to the availability of sensors and smartphones. It provides information about a person's daily routine that can help render e-health systems for the elderly and people with disabilities. The data collected from wearable sensors are used to classify human activities and movements, which forms an integral part of HAR.

We provide a comprehensive review of the various algorithms, including machine learning, probabilistic and logical, used in human activity recognition. Human activities such as walking, running, sitting, sleeping, standing, etc. are taken into consideration.

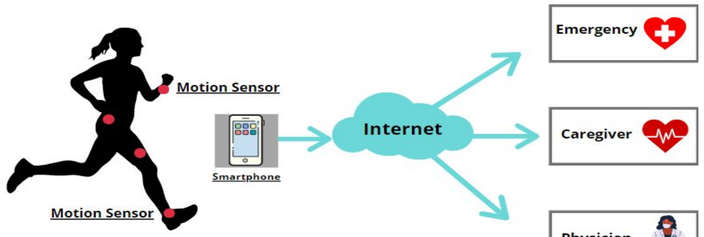

Fig 1: HAR in a smart healthcare environment

Results

1. Signals for ascending and descending stairs show more variation than simple walking.
2. High values of the detection probability estimate and low values of the type-II error estimate help distinguish walking and walking upstairs
3. Classification on PAMAP2 (Reiss and Stricker, 2012) dataset gave 90.11% and 93.2% accuracy with Random Forest and Naive Bayes respectively.
4. (Zhang, Tang, and Sazonov, 2012) and (Bao and Intille, 2004) report the highest accuracy with Decision Trees.

Methodology

Wearable sensors, mainly uniaxial, biaxial, and triaxial accelerometers, and Smartphones are used for data collection over multiple subjects performing different activities. (Bao and Intille, 2004) performed classification on user-annotated data by extracting mean, energy, entropy, and correlation features from acceleration data. (Ugulino *et al.*, 2012) classified activities into five categories namely sitting, standing, walking, sitting down, and standing up using features of variance of roll, module of acceleration, and Euler angles of roll and pitch.

Classification techniques

Machine Learning		List of Activities
• K-Nearest Neighbours • Decision Trees • Support Vector Machines • Random Forest • Neural Networks	• Multinomial Regression • Naive Bayes • Fuzzy Logic Systems	Sitting, Standing, Walking, Sitting down, Standing up, Walking upstairs, Lying, Walking Downstairs,Running, cycling, and Jumping.

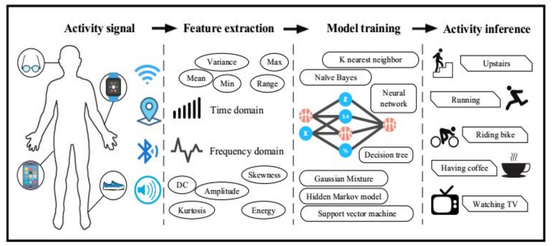

Fig 2: Sensor based HAR

(Zhang, Tang and Sazonov, 2012) performed classification using shoe-sensor using features like mean, standard deviation, entropy, variance, maximum value, number of mean crossings (NMC), mean absolute deviation (MAD). (Zemp et al., 2016) classified activities using data from pressure sensors mounted on office chairs and calculated backrest angle.

Conclusion

1. Some errors become common where the body movement becomes similar for e.g. ascending and descending stairs, sitting down and standing up, etc.
2. Sensor technology, along with machine learning, can classify different human body postures and movements correctly.
3. Different axes of accelerometers show important variation for different activities.

Discussion

Sensor technologies can offer insights into spinal cord injuries, sleeping disorders, etc. (Zemp *et al.*, 2016). Studies suggest that sensor systems and wireless accelerometers are able to detect everyday activities in naturalistic settings fast with high accuracy and lower computation cost if they are pre-trained initially (Zhang, Tang and Sazonov, 2012) (Bao and Intille, 2004).

References

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