

HUMAN PHYSICAL ACTIVITY RECOGNITION SYSTEM

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Summary. Human activity recognition (HAR) is a technique that somehow senses the human activities, analyzes the relevant information, and identifies the corresponding behaviors mode. This text introduces a kind of human physical activity recognition system based on frequency features.

Sensor-based human behavior recognition technology was launched in the 1990s, but now Human activity recognition play an important role in many fields, for example, in China, HAR systems can be used to identify the activities of patients, so that we can know the solution of the patients; In security and surveillance system, the HAR systems can be used to identify whether drivers have tired driving, hand-held phone driving and other violations; In shopping experience, the HAR system can be used to identify the behavior of customs, that can identify the shopping habits. Nowadays, there are many kinds of HAR systems, this text introduces a HAR system based on frequency features.

HAR system based on frequency features divided into four parts: the collection of the raw data, the preprocessing of the raw data, the extraction of features and the estimation of performance of the HAR algorithm.

Nowadays, most smart phones have a large number of tri-axial acceleration sensors with low in volume, low in power consumption and stable in performance, such as accelerometers, gyroscopes, etc., which can obtain high-precision movement and environmental data in real time and have strong data perception ability. The built-in sensors of smartphones can generally be divided into three categories: dynamic, location, and environmental sensors. So we can directly use the smartphone to collection the raw data. In the text, the selection of six common activities: walking, jogging, up the stairs, down the stairs, sitting, standing.

After the data collection is the preprocessing of the row data, it includes: window segmentation with fixed window with overlapping, filtering denoising by means of sliding median filtering and third-order Butterworth low-pass filter. The preprocessing of the raw data can remove glitches and jitter well, save the waveform features of the data, make the signal smoother, and the waveform periodicity is more obvious.

Then the extracted features were be finished. Some studies suggest that the use of efficient feature extraction methods may improve the final performance better than using efficient classifiers. Frequency domain analysis can observe the characteristics of the signal according to the frequency. Generally speaking, the frequency domain analysis is relatively simple, while observing the signal in the frequency domain makes the analysis of the problem more profound and convenient. The frequency domain feature extraction algorithm adopted in this text is a fast Fourier algorithm that can transform the sample signal to the frequency domain, extract the frequency domain features of the sample signal, and facilitate the frequency domain analysis. The frequency domain characteristic parameters adopted in this paper include center of gravity frequency (FC), mean frequency (MF), root mean square frequency (RMSF), frequency standard deviation (VF), etc.

The extracted features were classified using the classification function of the SVM, and finally the six categories of human behaviors were identified. Support vector machine (Support Vector Machine), first proposed by Cortes and Vapnik in 1995, show many unique advantages in solving small sample, nonlinear and high-dimensional pattern recognition, and can be generalized to other machine learning problems such as function fitting. The SVM algorithm is a supervised learning algorithm based on interval maximization, including both linear and nonlinear models. In the text, it is a muti-class classification problem, the problem was decomposed into multiple binary

classification problems, and the common methods include OVO (one vs one) and OVR (one vs rest),the text chose OVO multi-class classification algorithm.

Finally, a model of the human activity recognition system based on human physiology is developed, and this activity recognition algorithm can effectively identify 6 daily physical activities with an average accuracy of over 99 %.