Human Activity Recognition Using Wi-Fi Channel State Information (CSI)

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Channel State Information (CSI) describes the properties of a channel (i.e., the instantaneous amplitude and phase of a signal) in a wireless communications link. Transmitted Wi-Fi signals can travel through humans and objects, although there is an observed phase offset and decrease in amplitude at the receiver. The purpose of this project was to utilize collected CSI data to distinguish between three cases: (1) the absence of human activity within a room, (2) a stationary human standing in the middle of a room, and (3) a human continuously walking throughout a room. Whereas presently used detection methods, cameras and motion detectors, require specialized equipment to be installed, this CSI-based approach utilized existing Wi-Fi infrastructure already present in homes, schools, and public areas. Data was collected for one hour for each case, with CSI data over each antenna-to-antenna connection and subcarrier in a 3 x 3 MIMO Wi-Fi connection being logged every second. A linear support-vector machine (SVM) model in Matlab performed with 97.3% accuracy in a binary classification between case 1 (no activity) and case 2 (standing). When values from case 3 (walking) were introduced in a tertiary classification, the accuracy of the linear SVM decreased to 80.0%. This is likely because the distinguishing feature of the walking data was its amplitude and phase variance over time, which cannot be fully observed instantaneously. In the future, to improve accuracy in this tertiary classification, the variance of CSI values over a certain time period could be used by the classification model.

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