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# Activity Recognition and Daily Routine Modelling of Smart Home Residents

**Abstract**

Smart home has transformed life with automatic activity identification and behavior analysis, especially in multi-user setting. In this paper, we propose a novel method to analyze sensor-based activity data to extract patterns of activities, common tasks, and deviations in behavior across time. Through the use of machine learning models like BiLSTM, Random Forest, Tuned Random Forest, and XGBoost, the paper investigates the challenges associated with overlapping jobs, personal work schedules, and changes in work routines.

As for the performance of the models, XGBoost was the best model in terms of test accuracy with 91.39% by managing imbalanced data and giving importance to important features. RF and its tuned version performed very well with test accuracies of 88.31% and 88.90%, respectively, providing interpretability and generalisability. The BiLSTM was able to model the sequential relationships effectively but struggled with overlapping activities with a test accuracy of 73.66%.

In addition to activity classification, the work highlights behavioral deviation analysis for identifying changes in daily patterns. These deviations, which correlate with alterations in task frequencies and durations, are cues of developing health problems, adjusted behaviors, or altered social interaction. Results emphasize the value of smart home systems, not only to improve the daily living experience, but also to enable proactive health monitoring and deliver personalized care interventions.