A REVIEW OF DIFFERENT SOLUTIONS FOR AUTOMATIC FALL DETECTION AND ALERTING

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Introduction

- Automatic human fall detection is an important feature of systems for assisted living
- Designing a fall detection system can be split into three stages: designing the data acquisition devices, developing a classification method and validating the system using simulated or real falls and other activities of daily living (ADLs).

Fall pathology

- "Inadvertently coming to rest on the ground, floor or other lower level, excluding intentional change in position to rest in furniture, wall or other objects"
- Wide variety of different movements with some common characteristics
- „Long lie" period after falling has been linked to dehydration, pressure sores, rhabdomyolysis and pneumonia

Solutions for fall detection

- Wearable sensors (accelerometers, gyroscopes, barometers, foot pressure sensors, electromyographs)
- Ambient sensors (cameras, radar, floor pressure sensors, acoustic sensors)
- Accelerometer and camera systems are currently most common in use
- Smartphone-based solutions becoming increasingly used

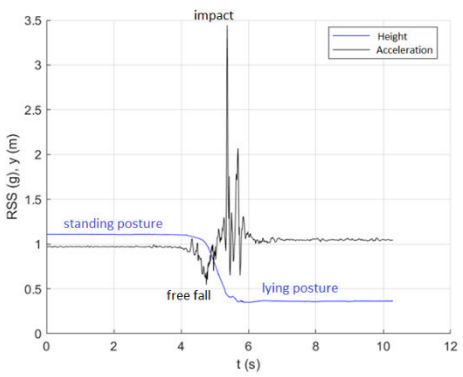

Figure 1: A record of a simulated fall. Height of sensor above the ground (y) and total acceleration (RSS) recorded during a fall. The fall in height indicates the change in posture from standing to lying, and the short peak in acceleration shows the impact.

- Threshold-based and machine learning classifier, often a combination of both to reduce computational needs
- Common features of falls are a hard impact, a free fall phase before the impact and a change in posture from standing to lying
- Training and validation are performed by processing of simulated fall signals and other activities of daily living records, often from publicly available datasets
- Major differences can be found between real world falls and simulated falls, as well as between different datasets due to lack of standardization in experimental methodology
- FER public datasets contain 1208 recordings of activities of daily living and 378 recordings of falls from 28 volunteers
- Future trends include subject-orientated classifiers, improvements in computational efficiency and integration with other systems of assisted living through the Internet of Things

Conclusion

- In this review we have provided an overview of the current and future trends in fall detection and on our own research in that field. Currently the most promising approaches are accelerometer-based and camera-based methods. Machine learning classifiers combined with threshold-based preselection reduce device power consumption while providing good performance. Smartphones and smartwatches are becoming more and more ubiquitous and provide a good platform for implementing fall detection for a wide variety of users.
- The main challenge for current fall detection systems is translating experimental success into real world performance. Improvements can be made in standardization of experimental methodology to help solve this problem.

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