

# ALGORITHM TO DETECT EPISODES OF FALLING BASED ON A GRID OF FLOOR SENSORS

Stephanie Nguyen, Michelle Nguyen and Douglas E. Dow  
Department of Biomedical Engineering  
Wentworth Institute of Technology, Boston, MA, 02115, USA  
nguyens2@wit.edu, dowd@wit.edu

## ABSTRACT

The risk of falling and becoming injured increases with old age. A system to monitor human activity and detect episodes of a prolonged fall could be used to access whether an alert should be issued for medical help. This project is developing software modules for analysis of data from a grid of weight sensors in the floor. The algorithm analyzes recent activity on each node to determine if weight has recently increased. Then regions consisting of adjacent nodes with recently increased weights are determined. These regions will be analyzed to determine whether they fit a profile of a fallen state.

## Keywords

grid, floor sensors, old age, frailty, alert, LabView

## 1. INTRODUCTION

The risk of falling increases with old age [5, 7]. The increased pharmaceutical medication of many older people increases the risk of negative effects on function, such as cognitive, sensory or motor function [1]. Balance and response time worsen with old age. If one were to fall, the risk of resulting injury increases due to frailty of bones [2-3]. In modern day society, more old people are living alone, compared to the pattern of society at the start of the twentieth century [4]. A person who becomes injured due to a fall while living alone may have difficulty calling for help. The longer the delay after injury before medical treatment begins, the worse the prognosis for recovery.

Devices and systems to help people call for help after a fall would be beneficial. The Life Alert device allows people to call for help after they fall, but would not be useful if they could not reach or were otherwise unable to use properly after the fall. A mobile phone could also be used to call for help, but would be even more difficult to use after a serious fall. A computer vision system with a camera mounted on the ceiling has been developed for detection of falls [6], but such a system may be considered intrusive. This project is developing software algorithms that would be used to analyze data from a grid of weight sensors on the floor of a residence, to detect possible episodes of a prolonged fall, for which a call for medical help should be made.

## 2. MATERIALS AND METHODS

The software algorithm is being developed in LabView (National Instruments, Austin, TX, USA). At each sampling interval, values

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, to republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

BODYNETS 2013, September 30-October 02, Boston, United States  
Copyright © 2013 ICST 978-1-936968-89-3  
DOI 10.4108/icst.bodynets.2013.253717

for weight from the grid of sensors in the floor would be digitized and stored in data structures. The recent activity on each node as reflected by the changes in values for weight was analyzed to determine whether the weight had recently increased. All nodes with recent increased weight were flagged. Then the algorithm searched for regions of adjacent nodes for which each node had recently undergone an increase in weight. The identified regions will then be analyzed to determine whether they fit a profile for a human who has fallen and is lying on the floor.

## 3. RESULTS AND FUTURE DIRECTIONS

Simulated floor weight values were input into the algorithm. A slope over the recent window of time was used to detect recent changes in weight on each node. Then, regions of adjacent nodes all having recent increases in weight were determined by the algorithm.

Further development and testing of the algorithm are required to access whether suitable for monitoring of human activity over long periods of time and for detection of potential falling events. A system that would detect episodes of falling and issue an alert for help would improve prognosis for recovery and quality of life.

## 4. REFERENCES

- [1] Akyol, A. D. Falls in the elderly: what can be done? *Int. Nurs. Rev.*, 54, 2 (Jun 2007), 191-196. DOI=10.1111/j.1466-7657.2007.00505.x.
- [2] Boyé, N. D., Van Lieshout, E. M., Van Beeck, E.,F., Hartholt, K. A., Van, D. C. and Patka, P. The impact of falls in the elderly. *Trauma*, 15, 1 (01 2013), 29-35. DOI=10.1177/1460408612463145.
- [3] Karlsson, M., Magnusson, H., Schewelov, T. and Rosengren, B. Prevention of falls in the elderly-a review. *Osteoporosis Int.*, 24, 3 (03 2013), 747-762. DOI=10.1007/s00198-012-2256-7.
- [4] Kramarow, E. A. The elderly who live alone in the United States: historical perspectives on household change. *Demography*, 32, 3 (Aug 1995), 335-352.
- [5] Larson, L. and Bergmann, T. F. Taking on the fall: The etiology and prevention of falls in the elderly. *Clinical Chiropractic*, 11, 3 (09 2008), 148-154. DOI=10.1016/j.clch.2008.06.001.
- [6] Lee, T. and Mihailidis, A. An intelligent emergency response system: preliminary development and testing of automated fall detection. *Journal of Telemedicine & Telecare*, 11, 4 (08 2005), 194-198. DOI=10.1258/1357633054068946.
- [7] Silva Fhon, J. R., Coelho Fabricio-Wehbe, S. C., Pereira Vendruscolo, T. R., Stackfleth, R., Marques, S. and Partezani Rodrigues, R. A. Accidental falls in the elderly and their relation with functional capacity. *Revista Latino-Americana de Enfermagem (RLAE)*, 20, 5 (Sep 2012), 927-934.