

Remote Fall Detection for Seniors

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Introduction

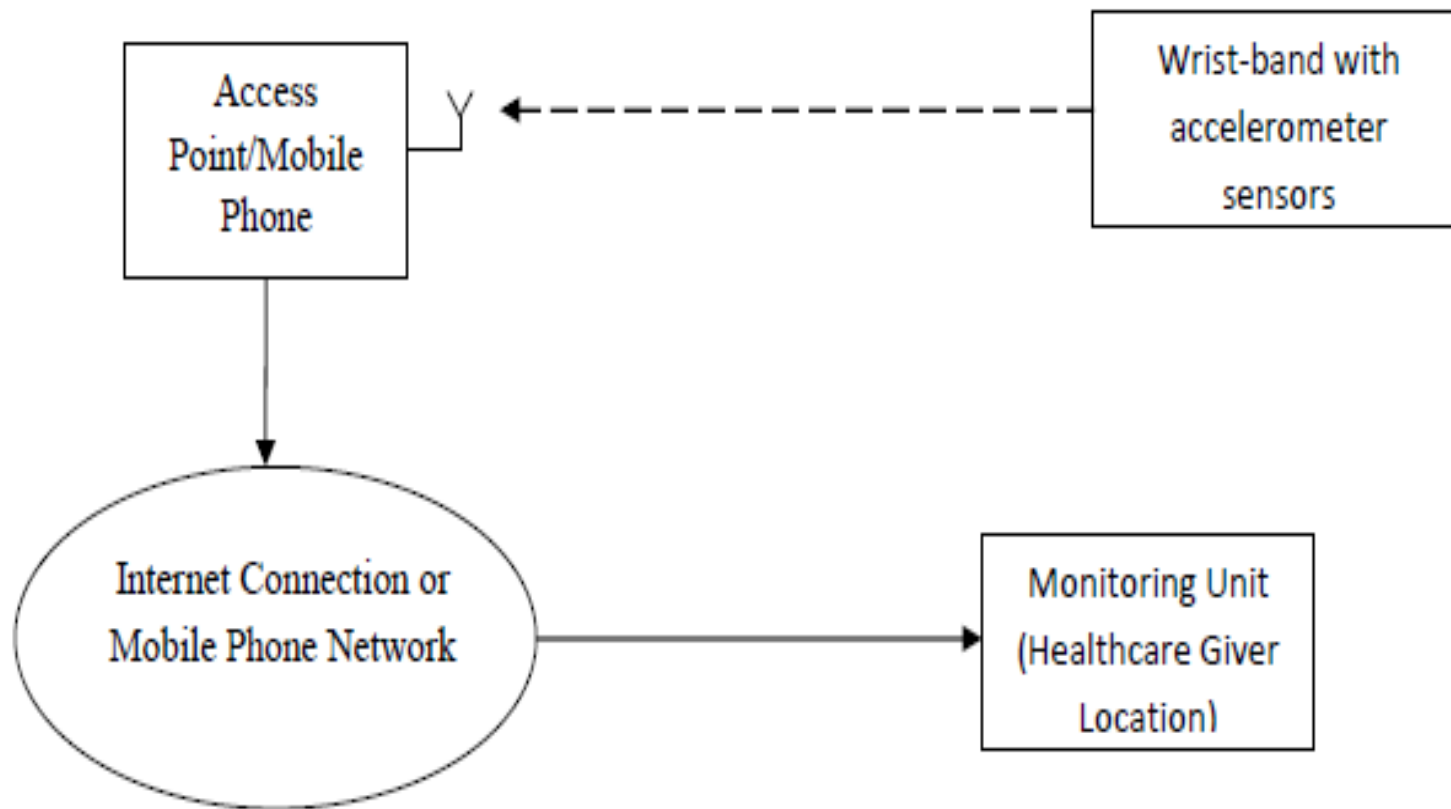
- The Public Health Agency of Canada in *Report on Seniors' Falls in Canada* [1] showed that
 - Falls are the second leading cause of injury-related hospitalizations accounting for 29% of injury admissions
 - Almost 62% of injury-related hospitalizations for seniors are the result of falls
 - The fall-related injury rate is nine times greater among seniors than among those less than 65 years of age
 - Half of seniors who fall experience a minor injury, and 5% to 25% sustain a serious injury such as a fracture or a sprain
 - Falls cause more than 90% of all hip fractures in seniors and 20% die within a year of the fracture.

A stack of books and a pen on a desk. The top book is yellow and has handwritten text in French: "Jolien", "Paroisses", "Promues et Casis".

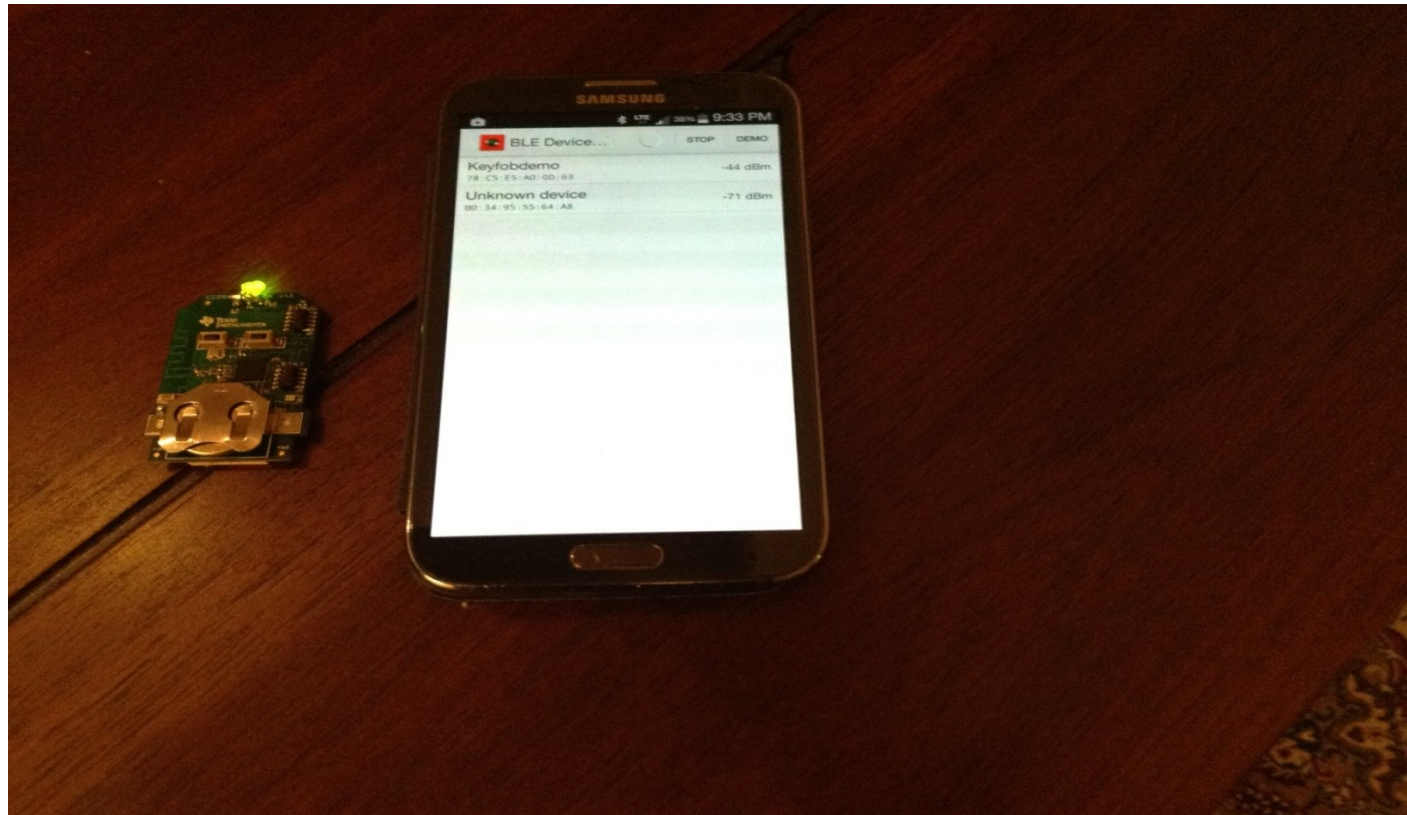
Introduction (cont'd)

- Wireless sensors for telemedicine have been considered for various applications in several studies (e.g., [2], [3])
- Fall detection, in particular, has recently been proposed in [4], [5]
- Falls are detected using accelerometers by utilizing the body movement parameters, such as the movement speed, acceleration and direction
- In this project, we designed and implemented a remote real-time fall detection system for seniors

System Design



Implementation

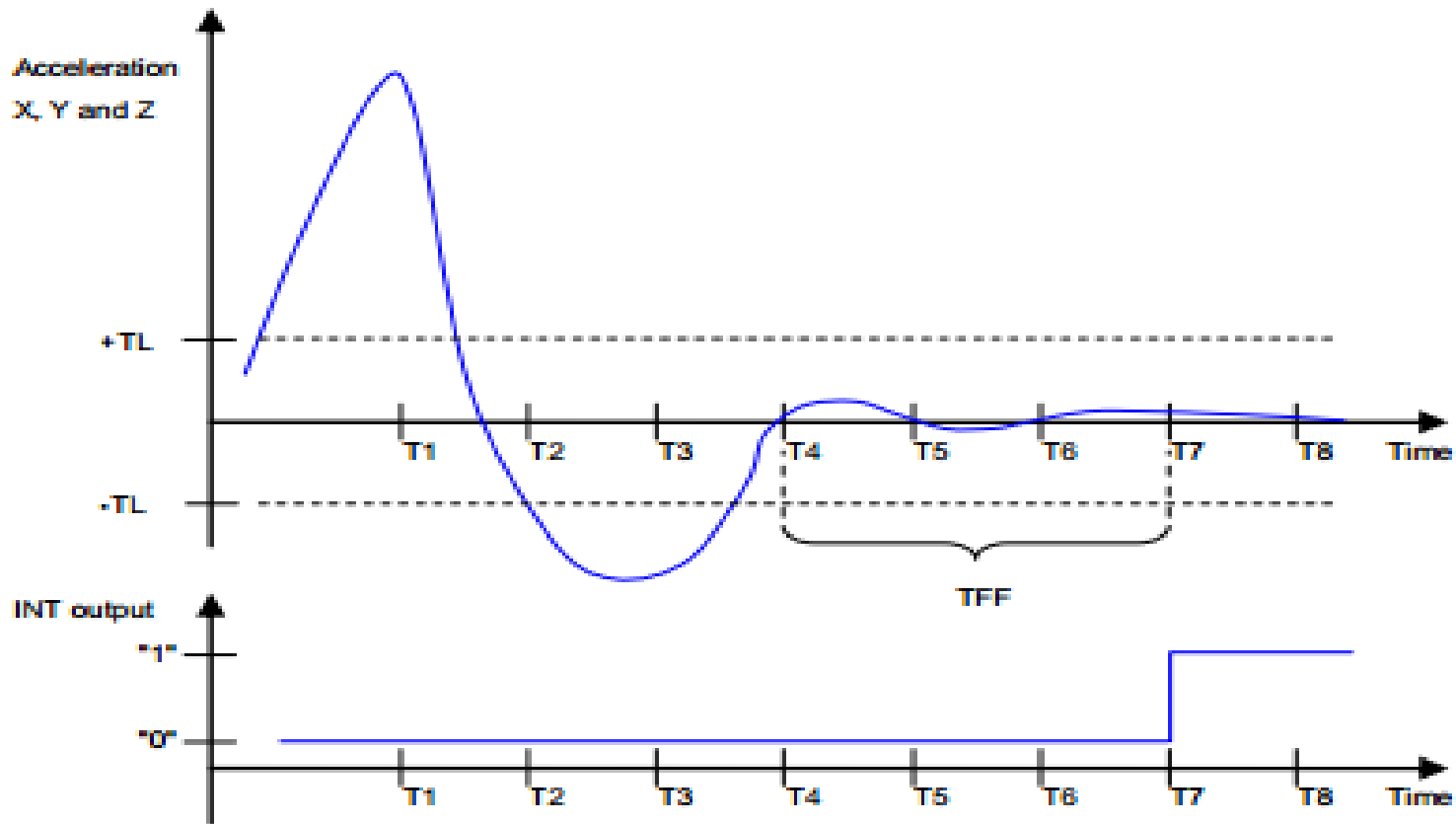




Implementation

- Two main components
 - Texas Instruments CC2540 Bluetooth mini development module (keyfob)
 - Mobile Android device with an app which receives a message from the keyfob once a fall has been detected, and sends a text message to a number of one's choosing
 - The keyfob includes a CMA3000 accelerometer which gives an interrupt when a free fall is detected
 - Free fall trigger conditions can be configured using two thresholds (the minimum duration of a fall & the maximum magnitude of the accelerometer reading)

Implementation





Implementation

- Communication range between the accelerometer sensor and the phone is up to 100 m
- Hardware cost is \$100
- Cost can be reduced if the system is produced at a large scale
- If smart phone is not available, a laptop, tablet, or any Bluetooth device can be employed
- The alert message can be sent as SMS, e-mail or voice message



Conclusions

- Remote fall detection has been designed and implemented
- The system was tested and showed good performance
- The system is simple, easy to use, and inexpensive
- More features can be added to the system (e.g., location information)
- Wireless sensor networks have many applications for seniors and medical care systems



References

- [1] Public Health Agency of Canada. Report on Seniors' falls in Canada. Ottawa, ON: Minister of Public Works and Government Services Canada, 2005. Available at: http://www.phac-aspc.gc.ca/seniors-aines/alt-formats/pdf/publications/pro/injury-blessure/seniors_falls/seniors-falls_e.pdf. Accessed October 15, 2012.
- [2] P. Bonato, "Wearable Sensors and System, From Enabling Technology to Clinical Applications," *IEEE Engineering in Medicine & Biology Magazine*, vol. 29, no. 3, May/June 2010, pp. 25-36.
- [3] J. Ko1, C. Lu, M. Srivastava, J. Stankovic, A. Terzis, M. Welsh, "Wireless Sensor Networks for Healthcare," *Proceedings of IEEE*, vol. 98, no. 11, November 2010, pp. 1947-1960.
- [4] F. Bagala, C. Becker, A. Cappello, L. Chiari, K. Aminian, J. Hausdorff, W. Zijlstra, J. Klenk, "Evaluation of Accelerometer-Based Fall Detection Algorithms on Real-World Falls," *PLoS ONE*, vol. 7, no. 5., May 2012, pp. 1-9.
- [5] R. Lee and A. Carlisle, "Detection of falls using accelerometers and mobile phone technology," *Oxford Journals - Age and Ageing*, vol. 40, no. 6, May 2011, pp. 690-696.



Questions

