An investigation into the development and implementation of a fall-detection and monitoring system using consumer electronics.

NUI Galway

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# Thesis Title

An investigation into the development and implementation of a fall-detection and monitoring system using consumer electronics.

# Thesis Statement

This thesis will investigate the development and implementation of a fall-detection and monitoring system to be implemented using consumer electronics. In the course of the thesis this investigation will be made up of a number of steps:  
 •    Conduct a literature review, and identify suitable imaging and computing technologies which may offer potential solutions.  
 •   Evaluate the state of the art of currently available fall detection systems, in terms of usability, cost and effectiveness  
 •    Design a system based on the knowledge gained through the literature review.  
 •    Implement and evaluate the effectiveness of this design.  
 •    Review the produced prototype against other solutions in the area.

# Scope & Significance

## Significance

Falls represent a significant cause of serious injury and death. According to the World Health Organisation falls account for 40% of all injury related deaths (World Health Organization, 2007). Older people in particular are more likely to experience a fall. The aforementioned study found that approximately 28-35% of people aged over 65 fall at least once per year, this figure increases to 32-42% when considering those aged over 70. Furthermore, falls accounted for more than 50% of injury related hospital admissions for people over 65.

Fall detection systems help to mitigate this risk and manage the damage when a fall event does take place. Additionally, fitting such systems in the home of people who are likely to experience a fall event will allow them to continue to lead independent lives, with the security of knowing that if a fall were to take place that appropriate people will be automatically notified. This has dual benefits of an improved quality of life for the person in question, as well as reduced care costs and load on health services.

Separately recent advances in consumer electronics mean that systems such as 3D cameras and small, reasonably powered full –featured computers are readily, widely and cheaply available. This project will seek to investigate the application of these technologies to the area of fall detection.

## Scope

A wide array of fall detection systems currently exist, with an equally wide array of methods of operation, ranging from insoles detecting a person’s gait (Talavera, et al., 2015) to camera based systems, to accelerometers worn on the body. A survey of these products will be made, with the merits and demerits of each system noted.

Additionally a investigation will be made of commercially available hardware/software solutions which may be applicable in the development of such a system.

Based on the results of this literature and documentation review a system design will be proposed and implemented. This system will be evaluated based on its design criteria, and against the other existing solutions and research identified during the literature review.

# Methodology Selection

This thesis shall use design science research as its methodology. This is suitable for this project as here the aim is to create and evaluate a novel system. There has been much prior work detailing the different research methodologies particularly the suitability of traditional scientific research methods, qualitative and quantitative, to the information sciences disciplines.

March and Smith (March & Smith, 1995) point out some key differences between research in the areas of the natural sciences and design sciences. They state that the area of natural science (these are the traditional sciences such as biology, physics, chemistry, etc.) is primarily concerned with studying and understanding natural phenomena whereas design science is focussed on ‘developing ways of achieving human goals’. That which is to be studied in the design science methodology is both created and evaluated – this is not the case in natural sciences.

Furthermore Vaishnavi and Kuechler (Vaishnavi & Kuechler, 2005), state that design science research involves creating new knowledge, through the design of new and novel artefacts and analysis of these artefacts.

The approach here will be to first evaluate the current state of the art in terms of commercially available fall detection systems, as well as research carried out in this area, any shortcomings of these systems shall be noted. An investigation will also be made in commercially available computing hardware which may be suitable for application to this area.

Following this research a design will be implemented and evaluated, both against its own criteria as well as the stated specifications of other available systems.

# Success Criteria

This project will be deemed successful by judging the success of each of its steps:

* Thorough investigation of current solutions both commercial and research based.
* Identification of design addressing shortcomings of these areas.
* Implementation of said design.
* Evaluation of implemented solution against design criteria and against other product.

# Project Plan

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| --- | --- | --- | --- |
| **Month** | **Phase** | **Deliverable** | **Completion Date** |
| Sept. | Definition | Initial thesis idea (informal) |  |
| Oct. | Definition/Planning  Research: Literature Review | Thesis Statement  Thesis Proposal | 16th Oct – completion of MCT624 |
| Nov. | Research: Literature Review | Biweekly supervisor email ‘check-in’ |  |
| Dec. | Research: Literature Review/primary research | Complete literature review. Detailed problem statement.  Biweekly supervisor email ‘check-in’ |  |
| Jan. | Implementation: Design Formulation | Biweekly supervisor email ‘check-in’ | MCT626 Module commence mid Jan |
| Feb. | Implementation: Design Formulation & System implementation | Detailed system design and specification  Biweekly supervisor email ‘check-in’ | MCT626 Module ongoing |
| Mar. | Implementation: System implementation | Biweekly supervisor email ‘check-in’ | MCT626 module complete early March |
| Apr. | Implementation: System implementation | Biweekly supervisor email ‘check-in’ |  |
| May | Implementation: System implementation & Evaluation | Completed system  Biweekly supervisor email ‘check-in’ |  |
| Jun. | Implementation: Evaluation | Detailed analysis of system performance  Biweekly supervisor email ‘check-in’. |  |
| Jul. | Completion: Write up | Biweekly supervisor email ‘check-in’ |  |
| Aug. | Completion: Write up & submission | Completed thesis | Thesis deadline TBD but ~ Aug 21th (Aug 21st last year’s deadline) |

## Gantt Chart

Click below for Gantt Chart.



# References

March, S. T., & Smith, G. F. (1995). Design and natural science research on information technology. *Decision Support Systems* , 251-266.

Talavera, G., Garcia, J., Rosevall, J., Rusu, C., Carenas, C., Breuil, F., et al. (2015). Fully-Wireless Sensor Insole as Non-invasive Tool for Collecting Gait Data and Analyzing Fall Risk. *Ambient Intelligence for Health* , 15-25.

Vaishnavi, V., & Kuechler, W. (2005). *Design Research in Information Systems*. Retrieved September 26, 2016, from http://desrist.org/design-research-in-information-systems/

World Health Organization. (2007, March 7). *Global report on falls prevention in older age.* Retrieved September 24, 2016, from WHO Home Page: http://www.who.int/ageing/publications/Falls\_prevention7March.pdf