

# People Wireless Monitoring in a Home Environment

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**Abstract**—The consistent increase in the world's elder population has been putting a lot of challenges regarding national development, sustainability of families and the ability of health care systems to provide for ageing populations. As wireless sensing technology continues to evolve, devices integrating low-power, low-bandwidth radios and a modest amount of storage, emerge due to considerable reduced costs. Wireless sensors based home monitoring systems provide a safe, sound and secure environment for elder people, enabling them to live in their own home as long as possible. This work introduces the Elder Monitoring System (EMoS), a MiXiM based framework, in which an Ad hoc On-demand Vector Routing (AODV) protocol has been implemented together with a modified HORUS system, for tracking and monitoring, in a home environment, elder people or people with special needs. The results obtained from this research demonstrate the feasibility to build a monitoring system for elder care using a simulated environment in which several aspects of the hardware commercially available have been also discussed.

**Index Terms**—Sensor Networks, Elder Care, Routing Protocols, Indoor Location

## I. INTRODUCTION

IN recent years, the increase in life expectancy has been putting a lot of challenges regarding national development, sustainability of families and the ability of health care systems to provide for ageing populations. During recent years the number of people in the world above 60 years has increased from 200 million in 1950 to 670 million, an ageing group that represents already 20% of the world's total population in developed countries [1].

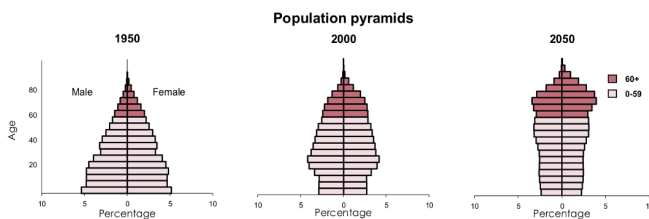


Fig. 1. Demographic pyramids for Portugal between 1950 and 2050 [1].

With the relocation of young people to the suburbs and the low birth rate, the number of elder people who live home alone is increasing. This situation creates a huge anxiety in all the people involved, resulting many times in early institutionalization in caring homes or other elder care facilities. Also people with physical or mental disabilities present identical

caring needs. For example, people with mild mental retardation usually achieve sufficient social and vocational capabilities for minimal self-support. Problems with these people occur because they have trouble getting in/out of bed on time. The lack of overview and planning skills to see that they have to go to bed on time in order to be able to go to work on time the next day.

Creating a system able to monitor people in this situation would allow specialized professionals to dedicate their work to other types of scenarios where a larger dependency would exist freeing costly and rare resources. As wireless sensor technology continues to evolve, devices integrating low-power, low-bandwidth radios and a modest amount of storage emerge with a considerable low cost. With a vast number of existing sensors, ubiquitous applications can emerge as a low cost alternative with huge added value for monitoring people in a home environment, providing a huge symbiosis between man and machine.

This work suggests the development of a system, where one or more persons, carrying a node with wireless capabilities, move around an environment where other wireless sensors exist. The system should be able to identify each individual and allow for communication with a central base station in a bidirectional way.

The rest of this paper is organized in the following manner.

In Chapter 2 a research about the state-of-the-art solutions is made with reference to systems that employ video, wearable sensors and home appliances sensors to monitor people in a home environment.

Chapter 3 talks about the related work, focusing on elder people needs in healthcare, through a study where interviews were made to Case Managers (CMs). This chapter also refers to the usage of wireless sensors for tracking and compares routing protocols.

In chapter 4 the work environment for the simulation is presented together with the difficulties in getting a simulator that can achieve a high degree of accuracy while simulating movement, obstacles and wireless sensor networks.

In chapter 5 the Elder Monitoring System (EMoS) is presented together with an evaluation of real hardware options commercially available, capable of implementing the system in real conditions.

Chapter 6 discusses and analyses results from the simulation. Conclusions and future work are presented in chapter 7.

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## II. STATE OF THE ART

### A. Monitoring using Video or Audio

Current smart home environments consist of several appliances and other devices, with sensors, actuators and/or biomedical monitors. These systems are used by the residents in a daily basis. In some situations the house is monitored using video and audio technologies, even tho they present some disadvantages like: high costs due to sophisticated equipments and specialized deployment, the need for a large bandwidth or privacy issues. Several state-of-the-art solutions were reviewed. In [2] falls are detected. In order to reduce the number of false alarms, the system integrates a WSN and a video system. Cameras activated by a wireless sensor tracking mechanism, are able to interpret the video signal and make decisions whether to call an emergency number or not. A voice communication IEEE 802.15.4 is also discussed through the usage of state-of-the-art radios capable of transmitting voice. In [3] and [4] an installed surveillance system is used to infer about the position of a resident. No interaction with the system is needed in order to locate the person. The usage of *Smart Cameras* allows to resolve the privacy issue of data transmission through air, with the possibility of some kind of spoofing existing, which would presents serious security concerns to the user.

[5] deploys another monitoring application in a care home. It refers to the need for more healthcare professionals and the small amount of time that each one of them has available for each elder. The volume of biomedical data gathered can improve the way that the care manager follows it's dependent. [6] refers to the term *aging in place* which represent a movement where elders live in an independent and safe manner in their own homes. Monitoring of falls but also utilitarian functionalities are implemented such as object detection, calendar, video-conference and address book. [7] uses video and audio to correctly deduce if a fall has happen.

### B. Monitoring using Wearable Sensors

The increasing reduction in size of wireless sensors is bringing to the market solutions that can track a person's health, independently of his location or activity. The possibility of smart clothes with built-in sensors sufficiently small and light to be carried without any discomfort enable the mass usage of such equipments in a medium term. In [8] the Body Sensor Network (BSN) is addressed. The system

### C. Part Three

Taking into account ...

[1]

## III. CONCLUSION

This paper presented ...

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