

# Chapter 18

## Sensors and their Application for Disabled and Elderly People

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### ABSTRACT

*Over the years, several systems have been developed in order to improve the quality of life of the disabled and elderly people. Moreover, many systems and devices have been deployed based on their necessities. All of these systems integrate sensors, in order to carry out their functions, and they combine the electronic field, for the sensing systems, and the mechanic field, for their mobile parts. In this paper, we will classify the sensors and their basic principles. The signals gathered by them usually have very low values, thus operational amplifiers are employed frequently to amplify these signals. Finally, we will show the most well known sensor applications for disabled and elderly people. It will be very useful for researchers that need to integrate sensors in their deployment.*

### INTRODUCTION

New technologies are a valuable instrument to mitigate the disabled and elderly people problems. When we speak about the disability concept (Ferreira, 2007), we refer to the fault of capacity or difficulty to carry out an activity that is considered as normal.

There are some statistical studies published that give the number of people that suffer some kind of disability. It is really surprising; according to the Statistical National Institute (INE), 8.5% (3,847,900 people) of the Spanish people declare to have some disability. In addition, more than 1.3 million need some kind of help to carry out the basic activities in their daily life. More than 60,000 are children and adolescents (INE, 2008).

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The illnesses that can affect and hinder the disabled people to accomplish their daily activities can be classified according to their nature. We distinguish the following ones:

- **Sensory illnesses:** That mainly affect the visual and auditory system and frequently it can reduce the tact sense.
- **Physical illnesses:** That it usually affects the movement and body coordination, organic illnesses.
- Metabolic and viral illnesses and cardiopathies among others are included.
- Mental and psychiatric illnesses.

The use of new technologies to develop devices for disabled and elderly people is being quite important. Our purpose, along the following pages, is to present different types of sensors and the way to process and amplify their signals. We will also show some commercial references in order to introduce the reader to the topic and analyze the circuits needed to sense the environment to facilitate the live for disabled and elderly people.

## WHAT IS A SENSOR?

A sensor is a device, formed by sensitive cells, that transforms physical or chemical magnitudes (instrumentation variables) in useful signals to measure or control systems (electric magnitude). The instrumentation variables depend on the type

of sensor and they can be temperature, distance, acceleration, inclination, displacement, pressure, humidity, pH, etc. The electric magnitude can be a value of electric resistance, an electric capacity, a voltage, an electric current, etc. A transducer and a sensor are different devices and they should be differentiated. A transducer is a device that transforms a physical magnitude into a different physical magnitude (such as mechanical energy or electric energy). A transducer can be a microphone that transforms an audio wave into an electric signal. A sensor is a device that provides an output signal, given by a specific physical quantity. The input value is called measure magnitude and it causes an answer in the sensor. An example is a linear variable differential transformer (LVDT), which converts a position into an electric signal (Nyce, 2004). Therefore a sensor can be considered as a transducer and vice versa. All sensors can be classified and included inside of one of the groups shown in Table 1.

Frequently, the signals obtained from the sensors are not useful to be processed and it is necessary additional circuits, as the Wheatstone bridge, or signals conditioner circuits, based on amplifiers, in order to adapt the voltage levels from the rest of the circuit. Most of these sensors offer us analog output signals and, in many cases, we need to adapt these signals in order to work with digital control devices like PCs.

It will be necessary to use an analog to digital converter. Figure 1 shows an example with all circuit blocks needed.

*Table 1. Sensors clasification*

Criterion	Type	Description
Energy contribution	Modulator	The output energy comes from an external source
	Generator	The output energy is given by the input
Output signal	Analogical	The output varies in a continuous mode
	Digital	The exit varies discontinuously
Operation mode	Deflection	The measured magnitude causes a physical effect in some parts of the device
	Comparison	It tries to stay the deflection to zero, applying opposed effects to the one generated by the magnitude

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