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Environment-Aware System for Alzheimer's Patients

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FINAL REPORT

Preparation for Dissertation for the
degree of Master of Science in Electrical and Computer Engineering

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2014

Abstract

The aim of the thesis, which is going to be developed at Fraunhofer Portugal and of which this is the preparation report is to create a small electronic device suitable to be used as a bracelet, a necklace or even incorporated into a piece of clothing.

This device should be able to check the environmental and body conditions in which the individual is, such as temperature and humidity, and also monitor the individual's movements, using for that appropriate sensors.

Since this is a mobile device, it must be able to indicate the position of the individual, so it will have a GPS navigation system.

Finally, for communication GSM-GPRS and Wi-Fi technologies will be analyzed.

As the device will be used to record the daily life conditions of the individual, and additional, it must have considerable autonomy for that.

Resumo

O objectivo da tese que vai ser desenvolvida com a Fraunhofer Portugal e cuja preparação é apresentada neste relatório é criar um dispositivo de pequenas dimensões, adequado para ser usado como uma pulseira, um colar ou até incorporado numa peça de roupa.

Este aparelho deverá ser capaz verificar as condições ambientais e corporais em que o individuo se encontra, tais como a temperatura e a humidade, e também os seus movimentos usando para isso, sensores adequados.

Tratando-se de um dispositivo móvel, este deve ser capaz de indicar a posição do individuo, para isso terá de ter incorporado um sistema de navegação por satélite GPS.

Para a comunicação serão analisadas as tecnologias GSM-GPRS e Wi-Fi.

O aparelho terá uma autonomia considerável para o uso diário uma vez que a monitorização deve ser feita 24 horas por dia.

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Abbreviations

ADLs	Activities of Daily Livings
CPU	
ETSI	European Telecommunications Standards Institute
FDMA	Frequency Division Multiple Access
GPS	Global Positioning System
GPRS	General Packet Radio Services
GSM	Global System for Mobile Communications
IMU	Inertial Measurement Units
MEMS	Micro-Electro-Mechanized-Systems
MLP	Multiple Perceptron
PC	Personal Computer
RF	Radio Frequency
RBS	Radial Basis Function
SAPM	Sleep Activity Pattern Monitoring
SVM	Support Vector Machine
TDMA	Time Division Multiple Access
USB	Universal Serial Bus

Chapter 1

Introduction

The population of Europe has been aging in these past few decades and Portugal is not an exception.

Alzheimer's disease affects about 90,000 people in Portugal (Alzheimer, Portugal), which makes this disease a public health problem. As this is a neurodegenerative disease, patients gradually lose autonomy [1].

Alzheimer's is a type of dementia that causes problems with memory, thinking and behavior. Symptoms usually develop slowly and get worse over time, becoming severe enough to interfere with daily tasks such as eating and performing daily hygiene.

This disease accounts for more than 60 percent of all dementia cases [1].

Alzheimer's is a progressive disease, where dementia symptoms gradually worsen over the number of years. In the beginning it's mainly memory loss, but in the advanced stages patients lose the capacity to carry on with a conversation or even respond to the environment.

Alzheimer's has no current cure, but treatments for symptoms are available and research continues. It cannot be stopped yet from progressing; the worsening of dementia symptoms can only be temporarily slowed to improve the quality of life for those with Alzheimer's and their caregivers. Today, there is a worldwide effort under way to find better ways to treat the disease, delay its onset, and prevent it from developing [1].

The observation of patients with Alzheimer's disease showed that they present great difficulties in performing activities of daily living and that, these changes, occur very early in the disease. These observations led to speculate whether patients with this condition do not present a deficit of attention, which would justify their inability to perform said activities [2].

Another identified problem consists of disturbances during sleep, which worsen with the disease's progression: a patient at an early stage can sleep for long periods of time while a patient in an advanced state is only able to sleep for a short time, getting to sleep in the afternoon or waking up several times during the night.

The objective of this thesis is the creation of a non-invasive device for the patient in order to be able to register the body temperature and humidity since Alzheimer's disease can cause sleep

disturbances, nightmares and agitation [3]. Another important aspect is the tracking of the patient and environmental conditions.

1.1 - Dementia

The word dementia comes from Latin “de” which means “apart” and “mentia” which means “mind”. Dementia is the progressive deterioration in cognitive function – the ability to process thought (intelligence) [4].

Dementia is a term used to describe various symptoms of cognitive decline such as forgetfulness, but is not a clinical diagnosis itself until an underlying disease or disorder has been identified. It is a collective term to designate brain disorders such as language, memory, and thinking.

Light cognitive losses happen as a normal part of aging, as we start to lose brain cells after our 20’s. This is known as age-related cognitive decline, not dementia because it does not cause any problem to the person. However when the loss of brain cells is markedly, and affects the daily life tasks, it is called dementia.

Dementia describes more than one type of symptom that really affects daily activities.

All dementias are caused by brain cell death and that can be triggered by a head injury, a stroke or even a brain tumor, among other causes [5, 6].

Alzheimer’s is a type of dementia and is caused by progressive brain cell death. It is estimated that 60 to 80% cases of dementia are Alzheimer’s disease.

The brain tissue in a person with Alzheimer's has progressively fewer nerve cells and connections, and the total brain size shrinks.

1.1.1. Dementia Signs and Symptoms

Persons with dementia may be self-aware of some of the problems common to the disease.

The following list was previously published by the American Academy of Family Physicians [7].

- Recent memory loss. All of us forget things for a while and then remember them later. People with dementia often forget things but never remember them. They might ask the same question over and over, each time forgetting it that was already answered. They won't even remember that they already asked that question.
- Difficulty performing familiar tasks. People with dementia might cook a meal but forget to serve it, and might even forget that they cooked it.
- Problems with language. People with dementia may forget simple words or use the wrong words. This makes it hard to understand what they want.

- Time and place disorientation. People with dementia may get lost on their own street, or forget how they got there and how to get back home.
- Poor judgment. Even a person that is well might get distracted and forget to watch a child for a little while. People with dementia, however, might forget all about the child and just leave the house for the day.
- Problems with abstract thinking. Anybody might have trouble balancing a checkbook; people with dementia can forget what the numbers are and what has to be done with them.
- Misplacing things. People with dementia may put things in the wrong places. They might put an iron in the freezer or a wristwatch in the sugar bowl. Then they won't be able to find those things later.
- Changes in mood. Everyone is moody at times, but people with dementia could have fast mood swings, going from calm to tears to anger in a few minutes.
- Personality changes. People with dementia may have drastic changes in personality. They might become irritable, suspicious or fearful.
- Loss of initiative. People with dementia may become passive. They might not want to go places or see other people.

1.1.2. Alzheimer's disease

Alzheimer's disease is a neurological disorder in which the death of brain cells causes memory loss and cognitive decline. A neurodegenerative type of dementia, the disease starts mild and gets progressively worse.

This disease progression can be broken down in seven stages of cognitive decline based on symptom severity - from a state of no impairment, through mild and moderate decline, and eventually reaching "very severe decline."[8]

Stage 1: No impairment (normal function). The person does not experience any problems. An interview with a medical professional does not show any evidence of symptoms of dementia [8].

Stage 2: Very mild cognitive decline (may be normal age-related changes or earliest signs of Alzheimer's disease). The person may feel as if he or she is having memory lapses – forgetting familiar words or the location of everyday objects. But no symptoms of dementia can be detected during a medical examination or by friends, family or co-workers [8].

Stage 3: Mild cognitive decline (early-stage Alzheimer's can be diagnosed in some, but not all, individuals with these symptoms). Friends, family or co-workers begin to notice difficulties. During a detailed medical interview, doctors may be able to detect problems in memory or concentration. Common difficulties include:

- Noticeable problems coming up with the right word or name.
- Trouble remembering names when introduced to new people.
- Having noticeable greater difficulty performing tasks in social or work settings.
- Forgetting material that one has just read.
- Losing or misplacing a valuable object.
- Increasing trouble with planning or organizing [8].

Stage 4: Moderate cognitive decline (mild or early-stage Alzheimer's disease). At this point, a carful medical interview should be able to detect clear-cut symptoms in several areas:

- Forgetfulness of recent events.
- Impaired ability to perform challenging mental arithmetic.
- Greater difficulty performing complex tasks such as planning dinner for guests, paying bills or managing finances.
- Forgetfulness about one's own personal history.
- Becoming moody or withdrawn, especially in socially or mentally challenging situations [8].

Stage 5: moderately severe cognitive decline (moderate or mid-stage Alzheimer's disease). Gasp in memory and thinking is noticeable, and individuals begin to need help with day-to-day activities. At this stage, those with Alzheimer's may:

- Be unable to recall their own address or telephone number or the high school or college from which they graduated.
- Become confused about where they are or what day is it.
- Have trouble with less challenging mental arithmetic.
- Need help choosing proper clothing for the season or the occasion.
- Still remember significant details about themselves and their family
- Still require no assistance with eating or using the toilet [8].

Stage 6: severe cognitive decline (moderately severe or mild-stage Alzheimer's disease). Memory continues to worsen, personality changes may take place and individuals need extensive help with daily activities. At this stage, individuals may:

- Lose awareness of recent experiences as well as of theirs surroundings
- Remember their own name but have difficulty with their personal history.
- Distinguish familiar and unfamiliar faces but have trouble remembering the name of a spouse or caregiver.

- Need help dressing properly and may, without supervision, make mistakes such as putting pajamas over daytime clothes or shoes on the wrong feet.
- Experience major changes in sleep patterns – sleeping during the day and becoming restless at night.
- Need help handing details of toileting.
- Have increasingly frequent trouble controlling their bladder or bowels.
- Experience major personality and behavioral changes, including suspiciousness and delusions or compulsive, repetitive behavior like hand-wringing or tissue shredding.
- Tend to wander or become lost [8].

Stage 7: Very severe cognitive decline (Severe or late-stage Alzheimer's disease). In the final stage of this disease, individuals lose their ability to respond to their environment, to carry on a conversation and, eventually, to control movement. They may still say word or phrases. At this stage, individuals need help with much of their daily personal care, including eating or using the toilet. They may also lose the ability to smile, to sit without support and to hold their heads up. Reflexes become abnormal. Muscles grow rigid. Swallowing impaired [8].

1.1.3. Caregivers

A caregiver is an unpaid or paid friend or relative that helps a disabled individual with his or her daily activities.

The role of the caregivers is to establish a good relation with the patient once that irreversible dementia requires a level of care that increases as the disease progresses.

Many families provide care at home for a person with dementia. While this can be an enriching and very rewarding experience, it also can be stressful; studies have shown that caring for someone with a brain impairing disorder can be more stressful than caring for someone with a physical impairment.[9]

Patients, who don't have access to home treatment, are treated in medical facilities and in this case the caregivers can be also doctors or nurses.

The device that is to be created in the scope of this dissertation can give assistance to caregivers since it will provide data about the physical state of the patients.

It can be useful in a variety of places and situations:

- In a house environment if for example the caregiver is able to access the condition of the patient even when the caregiver is not around.
- In locations such as day care centers to facilitate the control of both the persons with dementia as well as the environment that surrounds them.

- In a clinical environment to allow health professionals to follow the state of each patient in the unit.

1.2 - Proposed Project

In the later stages of the disease patients are not so autonomous, so it is usual for them to live in some medical facilities or have someone taking care of them.

The project being developed has the aim to create an electronic device with small dimensions, suitable to use as a necklace, a bracelet or even incorporated in a piece of clothing.

Because of its purpose it has to be built in a way that makes it indispensable for their daily life to make sure that the individual that is being monitored takes the device with him or her every day without being intrusive in their life.

The device should be able to collect data about the temperature of the environment surrounding the patient as well as his or her body temperature and humidity. Retrieved data can then be processed and analyzed to generate important records. This way, their caregivers can keep track of the patient's status and whereabouts and receive notifications should anything go out of the ordinary.

Another possibility that will be evaluated is to incorporate an accelerometer in the device that will allow monitoring the patient's daily routine, whether they are sleeping or awake. It can also be used for fall detection and in this case an alarm system should be activated to send their caregiver a warning notice about their condition.

The caregiver can be a family member, a friend, a nurse or even a doctor, so the interface should be easy to understand and comprehend and simple to work with.

Chapter 2

State of Art

Some advances have been made in the area of monitoring patients for medical health some of them focused in patients with dementia to improve their autonomy during the disease, or even to make their life easier through monitoring.

In Singapore in the project GPS (Grid-based Pipelined-parallel processing of Sensor data for circadian pattern identification and validation of manual recording) their focus is on the monitoring of activity of individuals predominantly at night, through the use of simple wearable accelerometers so as to extract information related to sleep activity patterns [10].

The device is designed to track the signals in indoor and outdoor environments and it is wirelessly connected to a smart-phone (Windows Mobile) through the bluetooth interface.

The smartphone acts as a gateway between the sensor and a remote server, transferring data collected from the sensor to the remote server through the public internet.

In Fig. 2-1 we can see the data flow of the processing sensor.

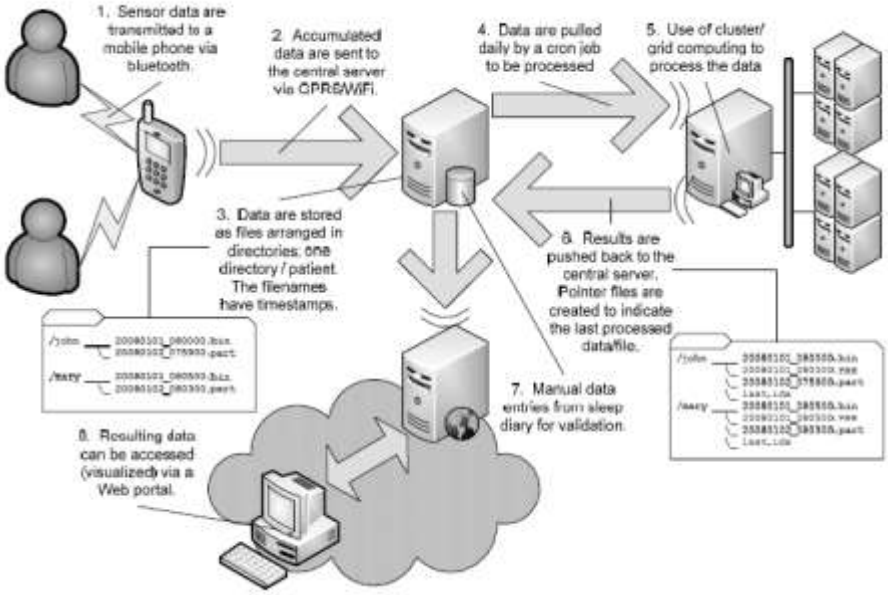

Figure 2- 1 Grid-based Pipelined-parallel processing of Sensor data flow [10].

In the Caussade hospital in France infrared, ultrasonic and pressure sensors were used in the care unit to help the caregivers monitor their patients as it can be seen in Fig. 2-3. This was an indoor system to control the movements of the patients that tried to be as less invasive as possible. However with this method it was impossible to identify who the sensors were detecting, the patient or someone else. So for that reason a patch that every patient had to use was created. The main objective of this project is to follow activities of patients in their living environment.

The patch system includes an accelerometer, a microcontroller and an 802.15.4 wireless transceiver. With the accelerometer they installed a fall detection system too.

The electronic patch was inserted into a hydrocolloid dressing (avoids redness) to secure it on the subject's back as shown in Fig. 2-2.

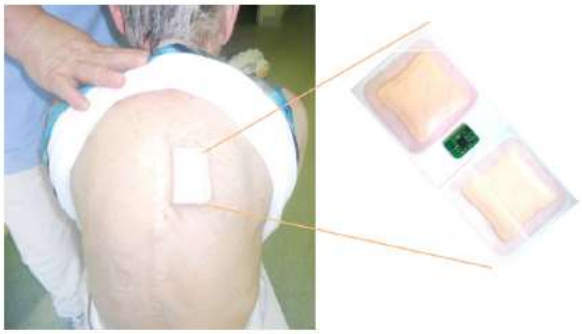

Figure 2- 2 The Patch applied on a Patient [11].

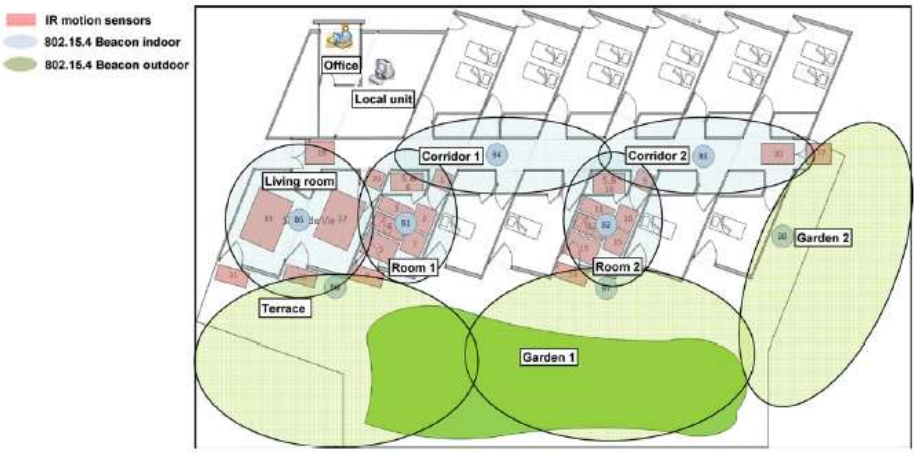

Figure 2- 3 Sensors distribution in the care unit [11].

The system was created to help caregivers monitor their patients suffering from Alzheimer's disease, in the Fig. 2-3 we can see the areas that are being monitored with the sensors and their range [11].

Another study in this subject made in the Faculty of Computing, Engineering and Technology, Staffordshire University in UK and the Department of Software Engineering, College of Arts, Media and Technology, Chiang Mai University, Thailand had the aim to create a device that could recognize and classify Activities of Daily Livings (ADLs) of an elderly person using small, low-cost, non-intrusive and non-stigmatized wrist worn sensors [12].

The main characteristics are represented in Fig. 2-4.

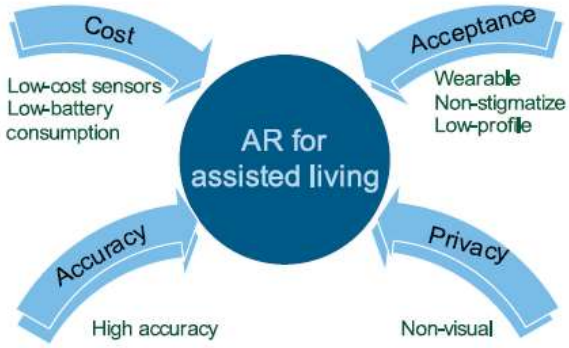

Figure 2- 4 Activity recognition for a practical assisted living system [12].

To achieve the desired goals, they used sensors like accelerometers, gyroscopes and a magnetometer as well as bio-sensors such as electrodes for measuring changes in skin conductance.

This work investigated three types of sensors, namely accelerometer, temperature and altimeter. These sensors are integrated on a normal sports watch as shown in Fig. 2-5.

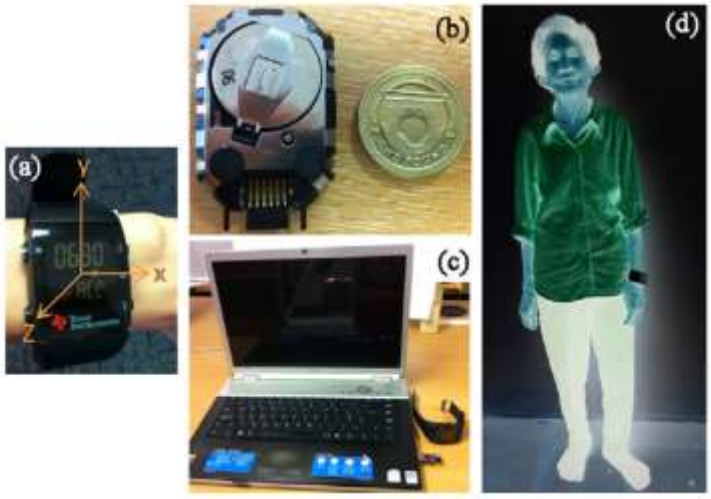

Figure 2- 5 Experiment equipment's and setup. (a) Acceleration axis. (b) A watch module compared to a pound coin. (c) Equipment used for experiments. (d) Sensor location on a participant [12].

The eZ430-Chronos watch was based on the CC430F6137 Microcontroller with the MSP430 CPU from Texas Instruments (2010). The watch has an integrated 868 MHz wireless transceiver which allows communication with the PC through a USB RF access point wirelessly.

The watch also contains 8 KB of flash memory available for data logging. The on-board accelerometer can measure acceleration in 3 dimension at a range of up to 2G (G = 9.81 m/s2) and a sampling rate of 33 Hz. The accelerometer actual sampling rate is 100 Hz, however, to reduce the energy consumption, the watch only transmits the third data set. The sample rate of temperature sensor and altimeter is 1 Hz.

Figure 2- 6 Participants carry out activities naturally [12].

The aim of the project was to identify daily activities; each subject had to use two watches, one in each wrist. In Fig. 2-6 we can see the subjects in their normal activities with one watch in each arm so the activities can be identified correctly. And the processing of sensor data flow is presented in Fig. 2-7.

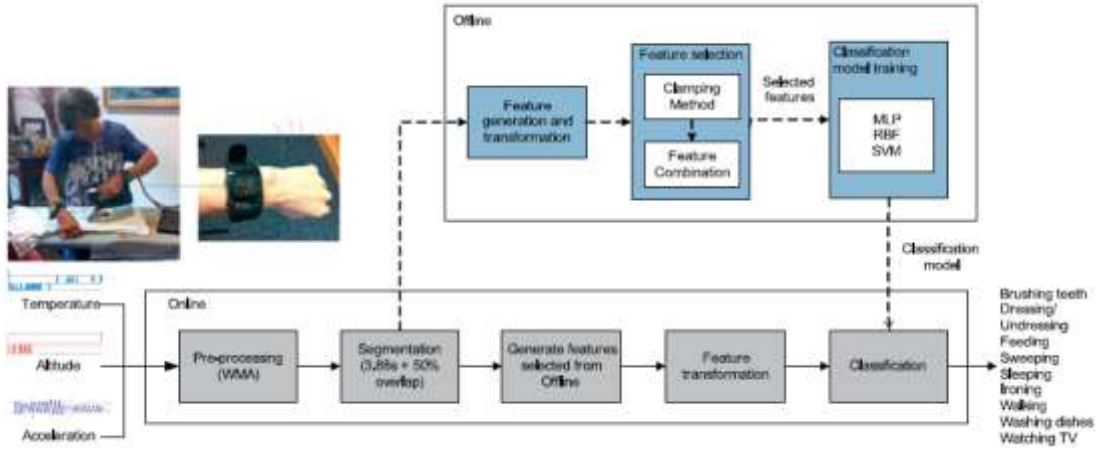

Figure 2- 7 the proposed activity recognition method to detect elderly ADLs using wrist-worn multi-sensor [12].

Another study in the Institute of Biomaterials and Biomedical Engineering at the University of Toronto has been made using accelerometers to detect falls or loss of balance.

The primary objective of this initial study was to develop a method to test and evaluate the effect of arm movements on the maintenance of postural stability [13].

In this study they analyze the effect of arm movement in the balance of individuals. And for that purpose they put the individual on an unbalanced platform and analyzed the movements of the arms through two accelerometers placed on each wrist (Fig. 2-8).

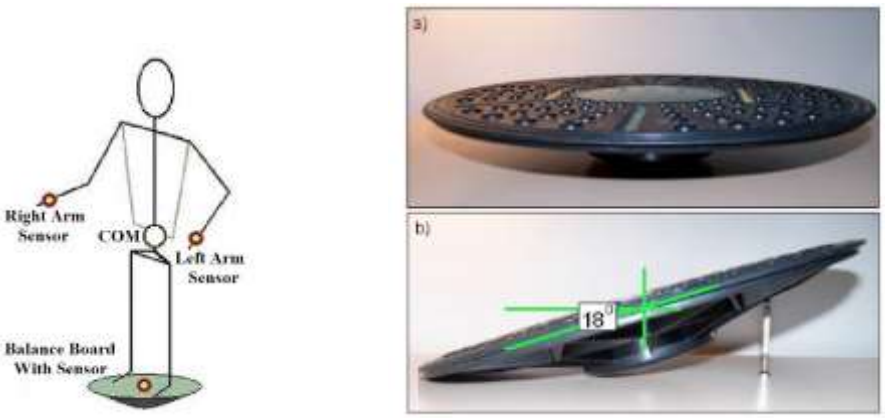

Figure 2- 8 Left: Accelerometer placement on both arms, COM = centre of mass. Right: the balance board [13].

With these kinds of studies it can be understand that accelerometers make the study of body movements possible this way.

Chapter 3

Project Approach

The following approach is not yet decided completely. However to fulfil the objective, we propose to build a sensor able to take samples of the environment surrounding the patient. In order to achieve this goal, we need to choose the kinds of sensors that we are going to use. To assure the physical wellbeing of the individual the environment temperature will be measured using a temperature sensor. With an accelerometer the aim is to create a system of alarms in case anomalies such as falls or out of ordinary routines occur. To properly address these scenarios and others that might make sense (e.g., sleeping cycle data), records concerning the patient's daily routine information will be kept.

Using this device we also propose to take measures of the body's temperature and humidity, to make sure that the patient is healthy and well.

In the next sections of this report the three kinds of sensors that will be used to assemble the device will be presented.

3.1. Sensors

3.1.1. Temperature

This thesis is focused in an aged group of people suffering from Alzheimer's disease. They are a group of people that are not so autonomous and need special care. Regarding that fact, temperature is one main factor that contributes for the wellbeing of people.

Temperature is a numerical measure of hot and cold. Its measurement is done by detection of heat radiation, particle velocity, kinetic energy, or by the bulk behavior of a thermometric material.

For our device, we will need two kinds of temperature sensors: one contact temperature sensor to measure body temperature, and a non-contact sensor to measure the environment temperature in which the patient is.

For contact sensors we have several available types:

- Thermocouples
- Resistance Temperature Detectors (RTDs)
- Full System Thermometers
- Bimetallic Thermometers

Non-Contact sensors:

Any of the previous sensors can be used to measure environment temperature.

3.1.2. Humidity

Humidity is the amount of water vapor in the air.

The amount of water in the air affects severely human wellbeing, as it affects the transpiration of the skin which regulates body temperature.

Capacitive humidity sensors with dielectric polymer will be analyzed to accomplish the objective this thesis.

The humidity sensor is a device that measures the relative humidity of a place and can be used for both internal and external areas. These sensors are offered in both analog and digital models.

A humidity sensor indicates the relative humidity by using a capacitive system.

It is usually made of a coating of glass or ceramic. The insulating material between the two plates is made of a polymer that absorbs and releases water depending on the relative humidity of an area as seen in Fig. 3-1-2-1.

Figure 3-1-2- 1 Humidity sensor [14].

This changes the level of charge on the capacitor and that way the humidity of a room or area can be measured.

3.1.3. Accelerometer

Human movement analysis is a field of wide interest since it enables the assessment of a large variety of variables related to quality of life.

Accelerometry offers a practical and low cost method of objectively monitoring human movements [15].

Accelerometers based on Micro-Electro-Mechanized- Systems (MEMS) technology have become the most used sensors in the study of human movement because they are small, light, wearable and non-invasive. These are some of the characteristics that we are looking for. Commonly these sensors are used with a microcontroller to process the measurements and also modules to enable communication with other devices [16].

Accelerometers are devices that can measure proper acceleration in each orientation that the device is set.

An accelerometer has two crucial parts, the housing that is attached to the device which we need to know the acceleration, and the seismic mass that oscillates with the movement of our device, and with that movement and the force of gravity it is possible to calculate the acceleration of our device.

Figure 3-1- 1 One direction accelerometer.

Figure 3-1- 2 Three-axis accelerometer.

Usually, three accelerometers are arranged in a single block, each pointing to an axis perpendicular to the other.

There are two main types of accelerometers: piezoelectric accelerometer;
capacitive accelerometer;

Piezoelectric material is a kind of material that has a convenient property: when compressed, it generates an electrical voltage. Higher pressure creates a higher voltage. This characteristic can be used to measure acceleration.

Fig. 3-1-3 shows a box which represents the housing, and the seismic mass. At the bottom of the box is settled the piezoelectric material.

If the box is steady the material is compressed by the seismic mass and in the terminals we have a voltage.

If we move the accelerometer up, the pressure will increase and consequently we will have a higher voltage. And if we move the box down the opposite will occur.

This way we have a voltage proportional to the acceleration of the box.

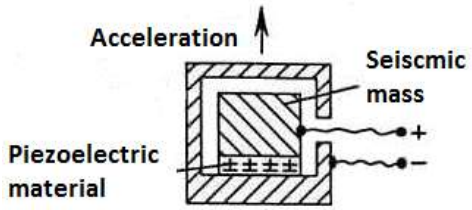

Figure 3-1- 3 Accelerometer scheme

The curve of the output voltage as a function of the angle of the accelerometer may be similar to that of Fig. 3-1-4. In this example, when the accelerometer is at 90° to the horizontal, the voltage at the output terminals is +V, in the reverse position, it is -V.

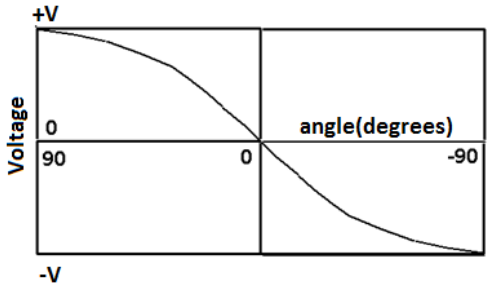

Figure 3-1- 4 Relation between the output voltage and the inclination of an accelerometer

A capacitive accelerometer can be pictured as two separated metallic plates with air or a suitable insulating material in between. If we load the two plates with electric charges of opposite signs as we see in Fig. 3-1-5, we have a certain voltage at the terminals. This voltage varies with the distance between plates. Closer plates give us lower voltages.

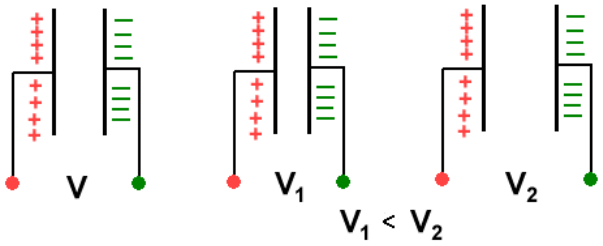

Figure 3-1- 5 Capacitive Accelerometer

If one of the plates is steady (housing) and the other plate acts like the seismic mass we have an accelerometer.

The position at which an accelerometer is placed on the body is crucial in the measurement of body movement. The accelerometer has to be attached to the part of the body that is being studied.

When we want to measure the movement of the whole body there are two options:

1. Multiple accelerometers;
2. One accelerometer placed in the center of mass as shown in Fig 3-1-6.

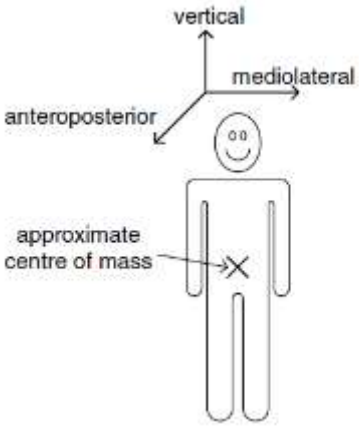

Figure 3-1- 6 The centre of mass of a person is located within the pelvis when standing upright.

With this kind of device we can study the movements of one's body. In addition to the more common activity tracking, this also allows us to try to understand interesting things such as when one's awake or sleeping.

It's relevant to know that with the technological advance circuits are getting more and more compact becoming really small. Fig. 3-1-7 presents one example of an accelerometer.

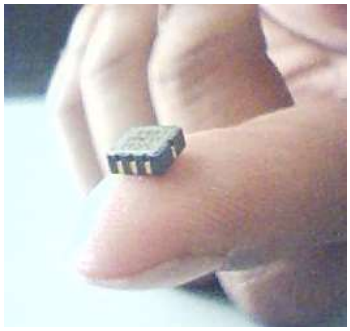

Figure 3-1- 7 Accelerometer [17].

3.2. Connectivity

3.2.1. GSM

The data regarding the temperature and humidity, presented in the previous section, in which the patient is in as well as its location and time will be sent to a control station using a wireless connection.

To achieve this we will research GSM/GPRS and Wi-Fi technology.

3.2.2. GSM/GPRS

GSM is the European standard for cellular communications developed by the European Telecommunications Standards Institute (ETSI) [18].

GSM has been widely adopted in the world.

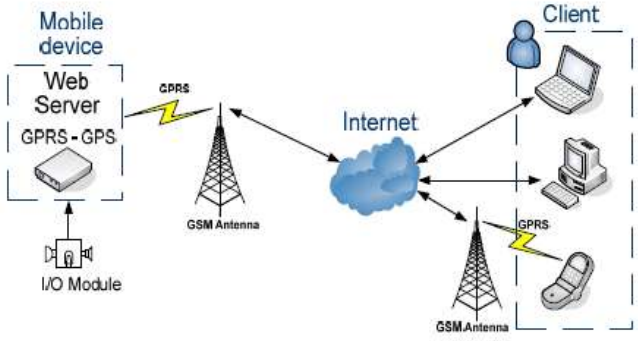

Figure 3-2-1- 1 General System Architecture [18]

However, maybe due to the great Internet development, mobile device users started to demand Internet connection in their phones but the GSM technic was not prepared for that, as soon as the data transference format was not the same.

GSM works in a circuit-switched mode; a channel is allocated to a single user for the duration of the connection. On the Internet data are transferred in packages so to accommodate that GPRS (General Packet Radio Services) was created, the so called 2.5 Generation.

GPRS is the major development in the GSM standard that benefits from packet-switched techniques; it was designed by ETSI to be implemented over the existing infrastructure of GSM without interfering with the already existing services, and that was possible because GPRS uses the same frequency bands and hopping techniques, the same TDMA frame structure, the same radio modulation and burst structure as GSM.

The package system allows a more efficient use of our resources since the network is only being used when there is something to transfer.

3.2.3. Wi-Fi

Wi-Fi, also known as Wifi or WiFi, is a very popular technology that allows an electronic device to exchange data and connect to the Internet using radio waves.

Several devices can use Wi-Fi technology, for example, personal computers, smartphones, digital cameras, video-games consoles and audio players. These devices can connect to a network such as the Internet via a wireless access point, also called hotspot. Each access point has a range of approximately 20 meters. Hotspot coverage can be as small as a room or as big as several square kilometers if multiple overlapping access points are used.

Like mobile phones, a Wi-Fi network makes use of radio waves to transmit information across a network. The computer should include a wireless adapter that will translate data sent into a radio signal. This same signal will be transmitted, via an antenna, to a decoder known as router. Once decoded, the data will be sent to the Internet through a wired Ethernet connection. As the wireless network will work as a two-way traffic, the data received from the Internet will also pass through the router to be coded into a radio signal that will be received by the computer's wireless adapter.

A wireless network will transmit at a frequency level of 2.4GHz or 5GHz to adapt to the amount of data that is being sent by the user. The networking standards will somewhat vary depending mostly on the user's needs.

Chapter 4

Work Plan

In this project, the affected elderly with dementia are our main concern and will be placed at the forefront of new technological advances and developments. We seek to monitor the condition of the disease.

The work plan consists of the following tasks:

A. Explore the use of external sensors to collect data on the condition and status of the person with Alzheimer's.
B. Design and test a custom sensor with multiple modules and aggregate data collected from them in order to warn caregivers of people with Alzheimer's and, where possible, help the people themselves. Develop an application along with the sensor.
C. Use the information from the sensors to create a database about the person and surrounding environment.
D. Benchmark critical and useful characteristics such as battery life.
E. Creating a working prototype.
F. Test and validate results.
G. Write the Thesis.

4.1. Calendar

	A	B	C	D	E	F	G
17-02 a 23-02							
24-02 a 02-03							
03-03 a 09-03							
10-03 a 16-03							
17-03 a 23-03							
24-03 a 30-03							
31-03 a 06-04							
07-04 a 13-04							
14-04 a 20-04							
21-04 a 27-04							
28-04 a 04-05							
05-05 a 11-05							
12-05 a 18-05							
19-05 a 25-05							
26-05 a 01-06							
02-06 a 08-06							

Table 4-1- 1 Calendar of the activities during the semester

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