A Neural Network Based Fall Detector

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Abstract

In this project we present an intelligent fall detector system based on a 3-axis accelerometer and a neural network model that allows recognizing several possible motion situations and performing an emergency call only when a fall situation occurs, with low false negatives rate and low false positives rate. The system is based on a two module platform. The first one is a Mobile Station (MS) and should be carried always by the person. An accelerometer is implemented in this module and its information is transferred via a radio-frequency channel (RF) to the Base Station (BS). The BS is fixed and is connected to a GSM (Global System for Mobile communication) module. A neural network model was built into the BS and is able to identify falls from other possible motion situations, based on the received information. According to the neural network response the system sends a SMS (Short Message Service) to a destination number requesting for assistance.

1. Introduction

Statistics prove that falls or emergency situations that lead to a fall in elderly people or critical groups are frequent. In some cases these groups live alone so there is no one to do the emergency call to assist them. Sometimes the lack of assistance can be fatal or lead to dramatic physical consequences. The faster medical assistance could be provided, the better are the chances of recovery or survival. In this context an automatic intelligent fall detector that executes an emergency call to a phone number or sends an SMS to someone that can perform the emergency call is very useful.
There are already some devices that realize similar functions [1]. However, its implementation is almost every time based on direct sensor information (like tilt sensors or infra-red detectors) that could lead the system to confound other situations to falls and perform false emergency calls.

2. System Architecture

The system is based in two modules: the BS and the MS. The Mobile Station integrates a three axis accelerometer as motion sensor, a microcontroller unit (Parallax Propeller with 8 processing cores) and a transceiver device to perform the communications with the BS (Figure 1).

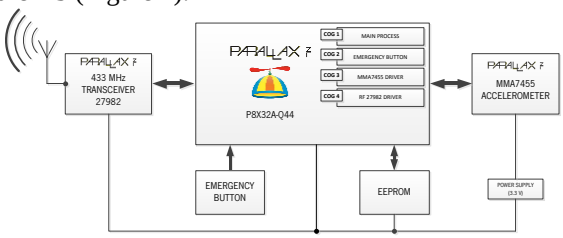

Figure 1 – Architecture of the Mobile Station.

The BS has the same microcontroller as the MS unit, a transceiver to receive data sent by the MS and a GSM module to perform the emergency call (Figure 2). The neural classifier was implemented in this microcontroller using C language.

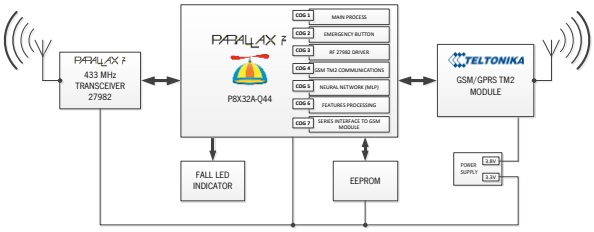

Figure 2 – Architecture of the Base Station.

3. Features Extraction and Neural Classifier

To accomplish the objective of this work, the system has to be able to distinguish several motion patterns. Basically, the system needs to learn the patterns that are associated to a fall situation and the patterns associated to other activities. To do so, it must go through a training phase during which several different situations are presented to the system (including fall and non-fall situations). During the training, the system must learn the main features present in each situation in such way that, after this phase, it will be able to