Chapter 45

Home Automation by Brain–Computer Interface

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ABSTRACT

In the present work, the authors use the Brain Computer Interface technology to allow the dependent persons the utilization of the basic elements of their house, such as turning on and turning off lamps, rolling up and down a roller shutter, or switching on the heating system. For doing this, it is necessary to automate these devices and to centralize its managing in a platform, which constitutes a domotics system. In order to achieve this, the authors have used the MindWave NeuroSky © commercial device. It is affordable, portable, and wireless, and senses and delivers the computer the electroencephalographic signals produced in the frontal lobe and the levels of attention, relaxation, and blinking to the computer. In order to determine the efficiency of the obtained signals a test software was designed, which verified the operation’s device with different persons. The authors conclude that the easiest way to control the attention levels is concentrating on a certain point, and the way to control the relaxation levels is by closing the eyes. As a second step, the authors develop a software that takes the signal from the EEG (Electro Encephalo Graphy) sensor, processes it, and sends signals via USB to an Arduino board, which is associated with electronics that complies the different tasks. The user chooses the action by managing the attention levels. When they are higher than a particular threshold value, the action is executed. In order to disable this action, the user must lower the threshold level and overcome it again. This is the simplest and fastest way to handle, but it brings several problems: if the user concentrates for any other reason and this signal exceeds the threshold, it causes the activation of an involuntary action. To solve this problem, the authors use a three variables combination that can become independent of each other thru training properly. These variables are attention, meditation, and blink. When you comply with the three simultaneous previously established conditions, the action is executed, and when they return to fulfill the conditions, the action is deactivated. The software also has the feature of personalizing its conditions, so it can be best for any user, even a novice one.

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INTRODUCTION

In Argentina there are a significant number of people with any type of motoric disability, leaving them unable to act autonomously in their daily lives. Considering this problem, we use the Brain Computer Interface (BCI) technology to allow these persons control the basic elements of their home. In order to do this, it is necessary to make an adaptation of those elements or devices – what is called an automation of them – and a centralized management by the user on a single platform. Usually this is called a Domotics System. Therefore, we can say that there is a connection between kinds of technologies: BCI and Domotics.

OBJECTIVES

Overall Objective

Allow an independent performance of people with difficulties or motor disabilities (but with an intact intellectual activity) into their home, and to improve their keepers services helping the tasks accomplishment by an automation an access of the house’s present devices through a Brain Computer Interface.

Specific Objectives

1. To study the operation of the Acquisition Signals’ device, MindWave.
2. To design the implementation system.
3. To make a software application, including:
   a. Acquisition of the sensed values.
   b. Based on these values, to execute the choice of a particular action (such as turn on a lamp).
   c. Send to an Arduino board a value representing the selected action.
4. To program an Arduino:
   a. To get the value that represents the action selected from the previous software.
   b. To set the corresponding state (1 or 0) in every pin of the Arduino board according to the action to perform. Each pin will have a device housing associated.
   c. To modify the operation of various devices located in a conventional home so they can be handled by the Arduino.

Target Users

Although the system can be used by anyone for fun, leisure or systems optimization, potential users and for whom this project is oriented are dependent persons, who have lost their autonomy because of a disability acquired secondary accidents, injuries or illnesses involving serious motoric problems and impeding their natural communication with the outside world.

According with Roberto Hornero these people can be classified according to their pathology, lesion or functional impairment in two groups (Sánchez, 2011):