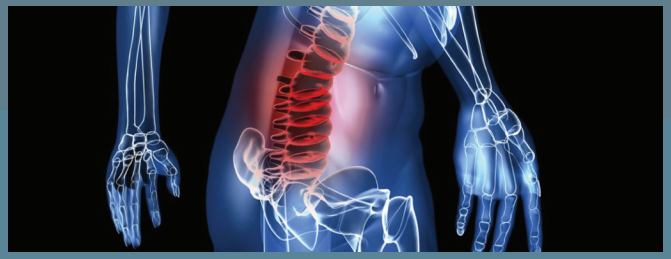
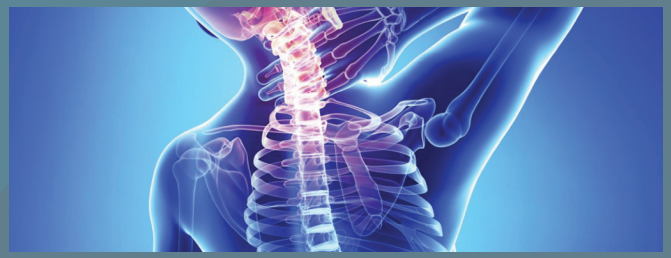
Neuromuscular Disease



The neuromuscular disease group, refers to a variety of disorders, e.g., Duchenne's MD (DMD), Becker's MD (BMD), Emery-Dreifuss MD, Limb-Girdle MD, Facioscapulohumeral MD, Steinert disease, Amyotrophic Lateral Sclerosis, etc.

All these mostly genetic diseases affect the skeletal muscles and often also the heart muscle. The symptoms include muscle weakness and progressive muscle wasting and onset varies from less than 4 years of age (in the DMD) to between 20 to 70 years of age (in the BMD). Each of these diseases has an incidence rate that varies from 1 to 30 in 100,000, and some of these affect primarily males (i.e., about 1 in every 3,000 boys worldwide are born with the most common form of the disease). Given these facts, the participants are expected to be primarily male (particularly in the DMD group) and the mean age of the population in the pilot trials to be a few decades younger than the PD group.

High Tetraplegia



Every year, 1 in 60,000 people are injured in the cervical spinal cord, with most common causes being the traffic accidents, falls and sports. In the UK every year, there are around 1,200 people with spinal cord injury, half of them with tetraplegia.

Since, the tetraplegia case in MAMEM refers to injuries; it is evident that the age could vary a lot within the selected population. To obtain statistical power, approximately 15 subjects per group will be recruited, while an additional group of people, diagnosed as healthy will participate in the pilot trials for evaluation purposes. The group of healthy people will match the characteristics of the three target groups, matching age and gender.

CONSORTIUM

Centre for Research and Technology Hellas - Information Technologies Institute (CERTH-ITI).
http://www.iti.gr

University of Koblenz – Landau (Ukob), WeST Institute.
http://west.uni-koblenz.de/

SensoMotoric Instruments GmbH (SMI).
http://www.smivision.com/

The Medical Research Infrastructure Development & Health Services Fund by the Sheba Medical Center (SMC) – (SHEBA).
http://www.sheba.co.il/

EB Neuro S.p.A (EBN).
http://www.ebneuro.biz/

3rd Department of Neurology of the Aristotle University of Thessaloniki.
http://www.med.auth.gr/

Eindhoven University of Technology (TUe).
https://www.tue.nl/

Muscular Dystrophy Association, (MDA Hellas).
http://mdahellas.gr/

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MAMEM

Multimedia Authoring and Management using your Eyes and Mind

http://www.mamem.eu

THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION
HORIZON 2020

ABSTRACT

Loss of the voluntary muscular control while preserving cognitive functions is a common symptom of neuromuscular diseases leading to a variety of functional deficits, including the ability to operate software tools that require the use of conventional interfaces like mouse, key-board, or touch-screens. As a result, the affected individuals are marginalized and unable to keep up with the rest of the society in a digitized world.

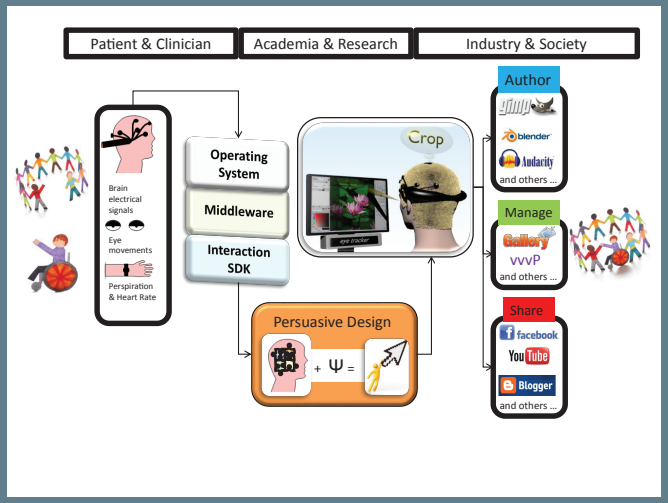
MAMEM's goal is to integrate these people back into society by increasing their potential for communication and exchange in leisure (e.g. social networks) and non-leisure context (e.g. workplace). In this direction, MAMEM delivers the technology to enable interface channels that can be controlled through eye-movements and mental commands. This is accomplished by extending the core API of current operating systems with advanced function calls, appropriate for accessing the signals captured by an eye-tracker, an EEG-recorder and bio-measurement sensors. Then, pattern recognition and tracking algorithms are employed to jointly translate these signals into meaningful control and enable a set of novel paradigms for multimodal interaction. These paradigms will allow for low- (e.g., move a mouse), meso- (e.g., tick a box) and high-level (e.g., select n-out-of-m items) control of interface applications through eyes and mind. A set of persuasive design principles together with profiles modeling the users (dis-)abilities will be also employed for designing adapted interfaces for disabled. MAMEM will engage three different cohorts of disabled (i.e. Parkinson's disease, neuromuscular disease, and tetraplegia) that will be asked to test a set of prototype applications dealing with multimedia authoring and management.

MAMEM's final objective is to assess the impact of this technology in making these people more socially integrated by, for instance, becoming more active in sharing content through social networks and communicating with their friends and family.

CONCEPT

MAMEM's overarching goal is to integrate people with disabilities back into society by endowing them with the critical skill of managing and authoring multimedia content using novel and more natural interface channels. These channels will be controlled by eye-movements and mental commands, significantly increasing the potential for communication and exchange in leisure (e.g. social networks) and non-leisure context (e.g. workplace).

It's cardinal objective is to facilitate the development of brain-computer interfaces that will lie between the disabled and the conventional interface of a software application dealing with multimedia content. These interfaces will be operated with an eye tracker, an Electroencephalography (EEG) recorder and additional bio-sensors (e.g., heart rate, galvanic skin response).



OBJECTIVES

• Capture, record and make available at the necessary scale, real-time and accurate information about eye-movements, brain electric signals and bio-measurements.

• Develop the necessary algorithms for translating this information into meaningful control that will take the form of semantic widgets.

• Implement a middleware sitting on top of current operating systems so as to make these semantic widgets available as elementary building blocks for implementing multimedia-related interfaces.

• Model users based on their (dis-)abilities, interaction behaviour, emotions and intentions and follow a set of persuasive design principles to develop interfaces that will effectively stimulate users to use them and encourage their behavioural change.

• Design, implement and evaluate a set of prototype interface applications that rely on MAMEM's middleware to execute the multimedia-related usage scenarios through the user's eyes and mind.

• Enable the use of prototype interface applications in non-controled environments, such as the home environment of the user.

• Assess the degree of success in bringing disabled people back to the society as a result of their newly acquired ability to manage and author multimedia content.

USE CASES

Parkinson's Disease

Parkinson's disease is the second most common neurodegenerative disorder after Alzheimer's disease and affects approximately seven million people globally and more than one million people in Europe.

The mean age of onset is around 60 years, although 5–10% of cases, classified as young onset, begin between the ages of 20 and 50. Early in the course of the disease, the most obvious symptoms are movement-related; these include tremor, rigidity, bradykinesia and postural instability. Later, cognitive and behavioral problems may arise, with dementia commonly occurring in the advanced stages of the disease, whereas depression is the most common psychiatric symptom. Other symptoms include sensory symptoms, sleep disorders and autonomic symptoms. From these symptoms, tremor, bradykinesia and rigidity are of interest in MAMEM, whereas the existence of cognitive and behavioral disorders is a reason for the potential user to be excluded from our pilot trials.

Tremor is the most apparent and well-known symptom. It is also the most common; although around 30% of individuals with PD do not have tremor at disease onset, it appears as the disease progresses.

Bradykinesia is commonly a disabling symptom in the early stages of the disease. Initial manifestations of this symptom are problems when performing daily tasks which require fine motor control such as writing, sewing or getting dressed.

In early stages of Parkinson's disease, rigidity is often asymmetrical and it tends to affect the neck and shoulder muscles prior to the muscles of the face and extremities. With the progression of the disease, rigidity typically affects the whole body and reduces the ability to move. Since PD appears most commonly in elderly population, it is anticipated that the people participating in the pilot trials of MAMEM will be in the mean age of 55 years old.