ANNEX A

PUBLIC SELECTION BASED ON QUALIFICATIONS AND INTERVIEW FOR THE AWARDING OF NO. 1 GRANTS LASTING 12 MONTHS FOR CONDUCTING RESEARCH IN ACCORDANCE WITH ART. 22 OF LAW OF 30.12.2010 NO. 240 AT THE DEPARTMENT OF ENGINEERING AND APPLIED SCIENCES OF THE UNIVERSITY OF BERGAMO (ACADEMIC RECRUITMENT FIELD 09/E3 – ELECTRONICS – ACADEMIC DISCIPLINE ING-INF/01 – ELECTRONIC ENGINEERING; (CUP: F12I14000230008).

announced with decree of the Rector Rep. no. 50 of 26.01.2017 and posted on the official registry of the University on 26.01.2017

RESEARCH PROJECT

"Body sensor network, flexible circuits and motion capture algorithm for the development of a highly automated, wearable base layer"

The research project aims at the development of a wearable sensor network for monitoring the movement and physiological parameters, for applications in hospital units specialized in the rehabilitation of patients affected by neurodegenerative diseases such as Parkinson's disease, stroke, infantile cerebral palsy and multiple sclerosis.
The movement analysis is one of the main research topics in today medical field. Through the calculation of the stresses and forces produced by a generic body segment, it is possible to design ergonomic prosthesis suitable for patients or athletes, thus reducing the possibility of rejection by the body. In the case of neurodegenerative diseases affecting the musculoskeletal system, it is possible through motor information to increase the knowledge on diseases and better control the rehabilitation process. In the context of cardiovascular diseases, the continuous monitoring of physiological parameters and motors allows easier diagnosis and more effective treatment .
From the clinical point of view, movement analysis is typically carried out by means of optical systems based on infrared technology. However, these systems have several disadvantages: they are expensive, difficult to use thus requiring the constant presence of specialized personnel, bulky, uncomfortable and not portable.
Recent advancements in electronic technologies has favored the development and spread of low-cost, miniaturized systems capable of measuring physiological and motor parameters. These tools are based on MEMS technology (Micro Electro-Mechanical System) combined with the computing capability of a microprocessor and a unit for wireless communication over short distances. With this type of technology, it is possible to realize wearable devices with reduced size (10 x 10 mm2) and limitedcost (tens of €) able to accurately estimate the motion of a limb.
In this project, it is proposed the development of a sensor network for the measurement of movement and physiological parameters, integrated on flexible substrates and fabricated in the form of a wearable support (base layer) with characteristics of elasticity, breathability and comfort. In particular, the research project is divided into the following activities:
1. Study of flexible electronic technologies needed to build a wearable system with sensors (1 month). This activity is based on the know how of the research team and the participating company.
2. Study and design of electronic blocks that have to be integrated on a flexible support. This activity will be initially focused on the single node used to measure the movement of a limb, and then on the integration of many nodes into a single network (3 months).
3. Development of firmware and algorithms for orientation estimating of the individual node and for the management of the wearable sensor network (3 months). This activity is carried out in parallel to the phase of production of printed circuits on a flexible support carried out by external companies.
4. Development of the firmware and the algorithms required for the analysis of rehabilitation protocols (2 months). During this activity, the methods for the analysis of the data supplied from the wearable system will be developed, in order to extrapolate parameters related to movement and physiological responses. Existing collaborations between the research team and some rehabilitation departments in hospitals of the Bergamo District will play a key role.
5. Characterization of the sensor network together with the rehabilitation units of the FERB Institute (Trescore Balneario) and of the Papa Giovanni XXIII (Mozzo) hospital (3 months). During the final phase, the first prototypes of wearable systems and the software for motion analysis will be provided to rehabilitation units. Assistance for the collection of data and the validation of the rehabilitation protocols will also be provided.