POLITECNICO DI MILANO

PhD in INGEGNERIA DELL'INFORMAZIONE / INFORMATION TECHNOLOGY - 39th cycle

Research Area n. 2 - Electronics

PNRR 117 Research Field: ELECTRONICS AND MICROSENSORS FOR SMART EYEWEAR

Monthly net income of PhDscholarship (max 36 months)
€ 1400.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	Here is a short description of motivations and objectives of the PhD research. 1- Develop hardware (microelectronics, sensors, cameras), firmware (programs for microcontrollers, Digital Signal Processors, Intelligent Sensors Processing Units) and software (Bluetooth/5G communication, power management, signal processing, user interfaces, etc.) useful to monitor physiological and environmental parameters. 2- Optimize and miniaturize the smart eyewear prototypes (frames, lenses, microelectronics, photonics, sensors, processing, battery charging, etc.) to minimize consumption and waste, maximize comfort and recyclability and develop new methods of mixed integration (not just frames and lenses) that optimize costs and ensure sustainability and circular economy, without however affecting the quality of the design. 3- Validate the sensors and electronics of the smart glasses in real application scenarios, devising tests and benchmarks to evaluate the quality and acceptability of smart eyewear. Development of experimental protocols for a technical validation of the developed senor systems.
Methods and techniques that will be developed and used to carry out the research	The PhD student will study, select and test components, sensors and electronic processors to be embedded into smart glasses. The electronics will pre-process signals

	from sensors placed inside the glasses' frame, using ARM-CORTEX microprocessors, commercial DSPs, and Intelligent Sensors Processing Units (ISPUs) to exploit in "smart eyewear" applications. The project will begin to design, build and test electronic circuitry for both the eyewear frame and for edge computing, initially based on commercial components and processing boards. Main activities are summarized in the followings. 1. Identification of the sensors - The activity will be focused on identifying the most appropriate sensor technologies and front-end circuits to meet technical performance and consumption requirements for being integrated into the frame. 2. Development of electronics for the acquisition and processing of sensor data - The activity will aim to define and develop the electronics that will have to interface with the sensors, to acquire their signals, condition them, filter them and process them. 3. Development of electronics for battery management, interfaces, interconnectivity - The activity will identify all the sub-blocks necessary to complete the smart eyewear electronics, from battery management to user interfaces (touch controls, touch, etc.) and connectivity to the edge (Bluetooth, WiFi, 5G, etc.).
Educational objectives	The educational objectives are the study, investigation and identification of the basic enabling technologies for vision integrated in intelligent eyewear, together with data analysis algorithms, to carry out a study of feasibility and have the basics to be able to design a first device prototype and start defining a test protocol and use cases. More specifically, the PhD students will work and collaborate with other researchers and PhD students on all the areas required to develop the "smart wear", namely: ELECTRONICS - identification of sensors to be integrated into the mount; electronic design on board for signal preprocessing; definition of architectures for battery management electronics, interfaces, communications. ALGORITHMS - development of preliminary algorithms to condition, filter and extract information from the acquired signals.

	INTEGRATION - preliminary integration of the sensors inside the frame of the glasses; evaluation of overall dimensions and partitioning of the electronics to be integrated in the mount and in the edge; sensor performance characterization tests and their comparison. VALIDATION - definition of the structures and architectures of the environments to be created, to validate the pre-prototypes; identification of the preliminary tests to be performed to characterize the subcomponents and the algorithms; preliminary preparation of the various laboratories and scenarios that emulate real environments in which to carry out the subsequent validation.
Job opportunities	The skills acquired by the PhD students will enable many different job opportunities. The main acquired skills are in the wearable system development, sensors applications, data processing with FPGA, DSP and SoCs, wired and wireless communication protocols, power management and energy harvesting. Collaborating with other PhD students and researchers, he/she will also get familiar with wearable sensors, AI and neural-network processing and AR/VR creation. The PhD student will work closely together with the employee of a big company such as Luxottica, developing team working skills both in research and business environments. All the acquired skills open the doors to many job opportunities especially as hardware designed and firmware engineer in electronics industries in all the application areas, such as wearable, medical, Internet-of-Things and embedded electronics.
Composition of the research group	1 Full Professors 2 Associated Professors 1 Assistant Professors 6 PhD Students
Name of the research directors	Federica Alberta Villa

Contacts
E-mail: federica.villa@polimi.it Phone: +39-02-2399.3490 https://www.deib.polimi.it/eng/people/details/583252

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	LUXOTTICA s.r.l.
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	University of Glasgow
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

EDUCATIONAL ACTIVITIES (purchase of study books and material, including computers, funding for participation in courses, summer schools, workshops and conferences): financial aid per PhD student.

TEACHING ASSISTANTSHIP: availability of funding in recognition of supporting teaching activities by the PhD student.
There are various forms of financial aid for activities of support to the teaching practice.
The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

COMPUTER AVAILABILITY: individual use.

DESK AVAILABILITY: individual use