POLITECNICO DI MILANO

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

Research Area n. 1 - Computer Science and Engineering

PNRR 117 Research Field: ADVANCES IN SMART EYEWEAR EYE-TRACKING ALGORITHMS AND APPLICATIONS VIA COMPUTER VISION AND DEEP LEARNING

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	The research aims at the development of novel techniques for the integration of Eye Tracking in Smart Eyewear devices and the development of novel applications based on these. In particular, the PhD candidate will investigate novel techniques in Computer Vision and Deep Learning for the analysis of users' gaze and intent from their eye movement. By applying Artificial Intelligence techniques we expect to reach high precision and robustness with limited computational power. We are interested also in exploring the potential of users' gaze estimation when performing scene understanding from an ego vision perspective. The overall scenario is meant to provide extended vision and augmented cognitive performance to the users of Smart Eyewear devices leveraging on the knowledge of their focus of attention.
Methods and techniques that will be developed and used to carry out the research	Methods and techniques that will be developed and used to carry out the research include algorithms for computer vision (e.g., 3D reconstruction, tracking, semantic scene parsing, …), and artificial intelligence (e.g., deep neural networks, machine learning, etc.). Some of the algorithms to be developed will be oriented to Eye tracking, position tracking, and egocentric vision. In particular, we want to understand from Smart Eyewear devices which parts of the scene people are observing, how they are moving

	within it, and how they are interacting with it so as to anticipate the users' intent and recognize particular contexts All these functions will then be validated in simulated environments in the laboratory and "in the wild" through existing viewers and eye-trackers, thus identifying the gaps in the market that the smart eyewear project will fill. Equipment for the acquisition of the position and the surrounding world will provide valid tools to obtain a quantitative validation of the goodness of the developed algorithms. Algorithms that will then be validated in real application contexts.

Educational objectives	PhD candidate will have the highest level of formation, leading to strong interdisciplinary expertise, along with continuous research activity in the latest AI and Computer Vision topics explored by both the scientific and industrial communities. The educational objectives are focused on the study, investigation, and identification of the basic enabling technologies for the development of intelligent eyewear, embedded AI, together with artificial intelligence and data analysis algorithms.
	
	The PhD students will work and collaborate with other researchers and PhD students on all the areas required to develop the "smart glasses", namely:
	
	 - ELECTRONICS - identified sensors and cameras to be integrated into the mount; electronic designed on board for signal preprocessing; defined eyewear / edge / cloud partitioning of algorithm processing; defined architecture of battery management electronics, interfaces, communications.
	  - PHOTONICS - identification of the photonic technologies necessary to produce a near-eye display; development of synthesis algorithms for digital holograms; implementation of digital color holograms on phase modulators (SLM) and their projection by laser light; characterization of holograms with video cameras.
	  - ALGORITHMS - development of preliminary eye-tracking and positioning algorithms using the selected

	sensors; experimented with the partitioning of the processing of some algorithms between edge and cloud; defined AI structure of action and object recognition algorithms.
	
	  - INTEGRATION - preliminary integration of the sensors and cameras 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.
	
	By the continuous interaction with colleagues having different skills and competencies the PhD student will develop a unique background easily applicable in different fields of research and innovation.

Job opportunities	PhDs will have excellent qualifications for both academia and industry where their need is widely acknowledged. The company involved in funding this research scholarship is highly interested in acquiring new highly skilled resources, but it is not the only one; the skills acquired during this PhD project will be highly appreciated by other companies in computer vision, artificial intelligence and intelligent systems.
Composition of the research group	2 Full Professors 1 Associated Professors 3 Assistant Professors 2 PhD Students
Name of the research directors	prof. Matteo Matteucci

Contacts
matteo.matteucci@polimi.it +39 02 2399 3470 https://www.deib.polimi.it/ita/personale/dettagli/267262

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)	Alexandre Bernardino ISR/IST
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.