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LAUNCH OF “MiSPiA” FP7 PROJECT

Milan, 9 July 2010 – “MiSPiA” (Microelectronic Single-Photon 3D Imaging Arrays for low-light high-speed Safety and Security Applications) is a new Collaborative research project funded by the European Commission in its Seventh Framework Programme for research, technological development and demonstration activities (2007-2013), and was launched in June 2010 under the coordination of the Politecnico di Milano, Dipartimento di Elettronica e Informazione. According to the Grant Agreement number 257646, signed between the Project Coordinator and the European Community, the project will be funded for € 2,632,854 for performing activities for 36 months in the field of photonics.

MiSPIA aims at two clearly identified 3D applications: high frame-rate, short-range (10-50m) 3D ranging systems for automotive prompt intervention for front- and back- pre-crash safety systems; and multi-spectral long-range (200-1,000m) 3D ranging systems for security surveillance. In the automotive field, moving or standing objects/obstacles to detect are vehicles, bicycle and pedestrian, small objects (trees, poles, etc.). Possible preventive or protective actions will be pre-crash warning (e.g. an acoustic warning signal), collision mitigation, pre-tensioning of safety belts, pre-setting of air bags. Instead Rear Pre-Crash is finalised to the rear impact detection and the automatic release of protective actions. Relevant objects/obstacles are any vehicles approaching with danger of crashing from behind.

On July 12 and 13 2010, more than 20 representatives of the MiSPiA consortium will meet in Milan for the project kick-off meeting, in order to start the project activities. They will have the occasion to present their expertise and know-how to the other members of the consortium, but also to discuss in depth requirements, specifications and constrains of the devices to be developed within the MiSPiA project.

Many social needs require the acquisition of images at low light levels (possibly with no artificial illumination), at video or even higher frame rates (possibly thousands of frames per second, fps), and also with distance-resolution (possibly millimeter precision). Nowadays the imager market offers a broad portfolio of either commercial- or scientific-grade cameras, ranging from consumer CMOS Active Pixel Sensor cameras up to high-end CCD imagers. None of them simultaneously offer high speed and ultra high sensitivity: CCDs reach sensitivity at close to single-photon level, but necessarily require cooling and long integration times (i.e. very low frame rates); APS imagers provide video-rates but with relatively limited detection efficiency, thus requiring bright illumination scenes. The MiSPiA concept is to provide simultaneously both high frame-rates and single photon sensitivity chips with monolithic integration of Single-Photon Avalanche Diode (SPAD) pixels and sophisticated in-pixel intelligence able to process at the pixel-level intensity-data and depth-ranging information, enabling 3D mapping of rapidly changing scenes in light starved environments.

MiSPIA proposes to exploit both standard CMOS technology, for cost-effective 2D imaging and 3D ranging cameras, and highly innovative beyond the state-of-the-art SOI/CMOS processing, for advanced imager performance.

MiSPIA's idea is to develop advanced microelectronic SPAD array chips able not only to count single photons ("single-photon counting"), but also to accurately tag them with their arrival time ("single-photon timing") and so provide a full image ("single-photon imaging") of the object under investigation. Therefore, MiSPIA aims to conceive, develop and fabricate photonic and microelectronic technologies for cost-effective manufacturing of very fast, highly sensitive, two-dimensional (2D) and three-dimensional (3D) SPAD cameras running at higher speed than standard video-rate.

MiSPIA consortium consists of 7 partners, who are among the leading European research groups in the fields of SPAD arrays and single-photon instrumentation (Politecnico di Milano, Italy), CMOS sensors fabrication and advanced SOI processes (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung E.V., Germany), design and fabrication of microlens arrays (Heriot-Watt University, United Kingdom), development of time-correlated single-photon counting detection modules and cameras (Micro Photon Devices s.r.l., Italy), safety applications in automotive field (Centro Ricerche Fiat scpa, Italy), then a leader in the security surveillance monitoring (EMZA Visual Sense Ltd, Israel) and finally CF consulting srl (Italy) with vast experience in the management and dissemination of European projects.

The MiSPIA Project will have major impacts on technological fields, application environments and end-user needs, because MiSPIA technology for SPAD arrays, 2D imaging and 3D ranging chips will define a new paradigm in the fields of silicon photonics and microelectronics integration and of advanced ultra-sensitive time-resolved and spectrally-resolved imaging. Not only Safety and Security scenarios will benefit by MiSPIA cameras, but also completely different fields. The European Union will become more and more competitive against USA, Japan and Canada and will acquire a renowned leadership in conceiving, manufacturing and deploying ultra high sensitive and fast camera sensor chips and systems.

Novel photonics components will push towards further chances to achieve MiSPIA foreseen impacts. Growing progress in laser and LED sources, with higher efficiency and different wavelengths, can improve the 3D scene illuminator (hence signal quality and SNR), the multi-spectral ranging approach (e.g. to near ultraviolet), and the overall 3D system compactness. Also, progress in CMOS technologies, crystallographic quality, and manufacturing yield will render the SPAD chips even more appealing, due to performance improvements (e.g. lower dark-counting rate and afterpulsing, higher uniformity, etc.), and costs reduction.

Innovative scientific research and growing studies on single-photon detectors and time-resolved techniques can raise interest for further developments of smart-pixels and arrays within the MiSPIA project.

Finally, the microelectronic scalability of the proposed MiSPIA CMOS SPAD imagers will positively impact on further advancement on SPAD array density (toward megapixels), in-pixel smartness (more complex in-pixel and on-chip processing), and overall imager compactness.