Vision, Identification, with Z-sensing Technologies and key Applications

Newsletter – June 2020

The VIZTA project has reached one-year activity, several meetings have gathered the representatives of all partners, the work got off to a good start, and fruitful results have already enlightened the collaboration between the partners.

VIZTA objectives and means

The objectives of the project are to develop innovative technologies for optical sensors and laser sources, for short to long-range 3D-imaging, and demonstrate their value in several key applications. Such objectives are addressed by building partnership ecosystems, exercise new 3D sensors and light sources in the key applications, using the new developed innovative technologies.

VIZTA progress: significant steps in 12 months

We propose hereafter a compilation of the different partners contributions starting from Technology developments, then components and application systems for short and long-range up to actions of exploitation and dissemination.

The VIZTA project developments are structured in 3 Work Packages (WP) focusing several tasks. Please have a look at the global project organization page for more details.

The WP2 is dedicated to advance device and technology development needed for the demonstrators used in the other WPs, and subdivided in 5 main tasks:

- SPAD (Single Photon Avalanche Diode) and lock-in pixel development: **ST** and **CEA** have collaborated to manufacture pixels for Time-of-Flight products using SPADs and lock-in pixels in STMicroelectronics' proprietary 3D stacked technology. Good progress has been made towards final pixel performance target. Characterization of all relevant figures of merit was carried out on initial material and further process optimisation and characterization will take place in the coming months.
- RGB+Z matrix at pixel pitch of 3.6 µm has been designed by **CEA** and processed by **ST**. The full demonstration of this device requires local filtering of infrared and visible light at pixel level to be able to generate a coloured 3D image. For this purpose, a new deposition tool from **AMAT** has been implemented in **CEA** cleanroom for optical interference filters deposition. IR-CUT and IR-Band Pass filters have been successfully deposited and characterized on 300mm Silicon wafers. A first mechanical demonstration of IRCUT + IRBP deposition on CMOS is almost terminated and will be characterized after last process steps in **ST** cleanrooms (color resist and micro lenses). Next steps are electro-optical validation of IRCUT filter only on ST CMOS wafers. Further developments have started for cross talk minimization and compensation of filter thickness.
- Double-stacked hybrid bonding short Loop wafers have been provided by **ST** to **SEMILAB** for first characterization using various measurement technics. Wafers had been pre-characterized at **ST** facilities using Scanning Acoustic Microscopy (SAM) and nano-topography measurements. SAM and IR depolarization inspections are compared to assess for the sensitivity of the respective techniques to the presence of Voids generally armful for the bonding quality. The next step is to better understand the origin of the observed stress and its potential impact in the bonding quality.

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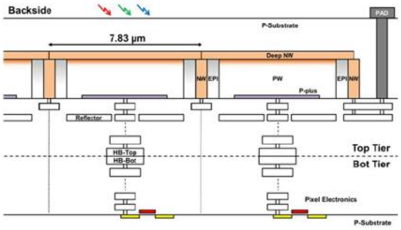
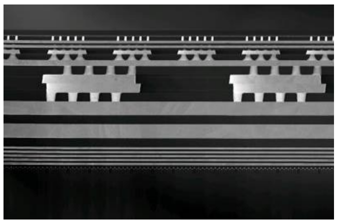
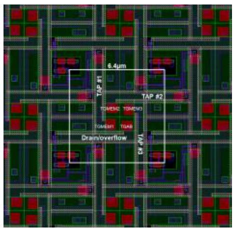
- Process integration carried out at **CEA** has shown good progress to develop an alternative to the face-to-face hybrid bonding architecture available today for many market products. The face-to-back hybrid bonding architecture developments of VIZTA provide good results for Silicon wafer thinning down to 5µm and compatible with direct bonding quality prior to small TSV last fabrication. 1 µm diameter TSV etching has been achieved on direct bonded wafers with expected profile for the perspective of a small 3D hybrid bonding pitch.
- The feasibility of the VCSEL concept with 10 addressable zones and integrated GaAs optics for beam shaping has been successfully demonstrated by **TRUMPF**. Chips have been made and characterized, routes for improvements along the next project phases are identified.



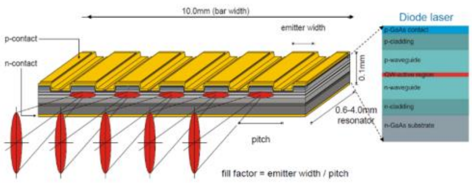
Advanced SPAD_3D



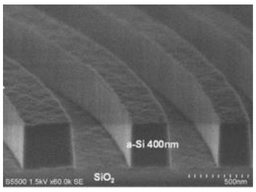
Hybrid Bonding solutions



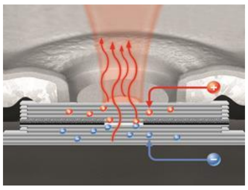
Lock-in pixels



High power Laser bar



Diffractive micro-lenses



VCSEL with integrated optics

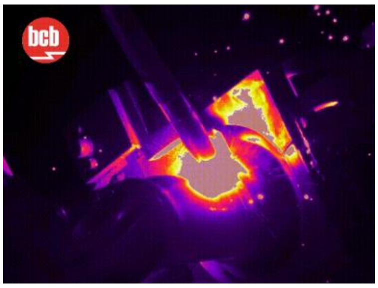
The **WP3** consists in development and realization of several demonstrators of Z sensing applications with low range 3D sensors: Biometric system, in-cabin monitoring system, smart building management, 3D multi-camera system for Industry 4.0, automotive driver monitoring systems with 3D mapping and finally mobile robotics for smart cities.

After 12 months of activity, WP3 partners **IDEMIA**, **IEE**, **DFKI**, **ISD**, **EDI**, **BCB**, **AAA** and **EURECAT** achieved and submitted the specifications of applicative demonstrators based on **ST** upcoming available Z-sensor (ToF) prototypes. WP3 partners **ST**, **IDEMIA**, **IEE**, **DFKI**, **ISD**, **EDI**, **BCB**, **AAA** and **EURECAT** started in field evaluation and share each month their progress and technical challenges.

People identification

Smart city and buildings

In-cabin monitoring



Industry 4.0

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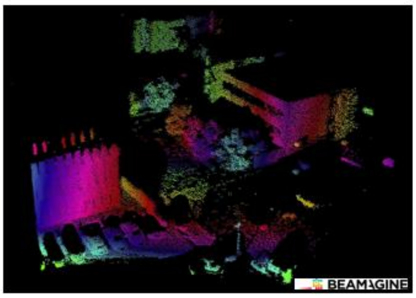
The WP4 consists of **two automotive LIDAR demonstrators**, one focusing on a Medium Range LIDAR (MRL) unit and another one for Long-Range LIDAR (LRL) with the development of appropriate optical sources and detectors. The 2 developed solutions aim to overcome the cost and reliability drawbacks of current LIDAR systems and address the problem of perception capability in restricted visibility conditions with adverse weather conditions. Further processing of said point-cloud for example to generate target detection and classification are not covered in the project.

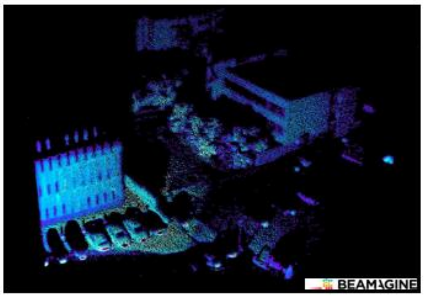
- The MRL demonstrator will operate at around 900nm wavelength and aims an automotive application related LiDAR demonstration with a TRL of 3 to 5 and being true solid-state without any moving parts. The MRL consortium involves the partners **ST**, **CEA**, **III-V-LAB** and **IBEO Automotive Systems**. The R&D work targets a large sized latest generation SPAD array with enhanced sensitivity and an efficient high power 2D scanning Optical Phased Array approach. Technology developments in the area of high-power laser diodes with high beam quality and GaN related laser drivers complete this work package. Together with novel scan and signal processing algorithms a way will be paved to achieve a compact and low-cost medium range LiDAR.

- The LRL demonstrator use the more eye safe wavelength at 1550nm. The longer 1550nm wavelength will allow a higher emitted power level while maintaining eye safety class 1 level. A multiplexed single point detector will be used. The LRL demonstrator involves partners **III-V Lab**, **Beamagine**, **CEA**, **Keopsys**, **Lumibird**, **UPC** and **Veoneer**. For timing and financial reasons, the sensors in the proof-of-concept demonstrators will not comply with any ultimate production targeted units but are selected to achieve a reasonable demonstrator to prove the viability of the sensor systems to affordably achieve increased performance even in adverse weather conditions.

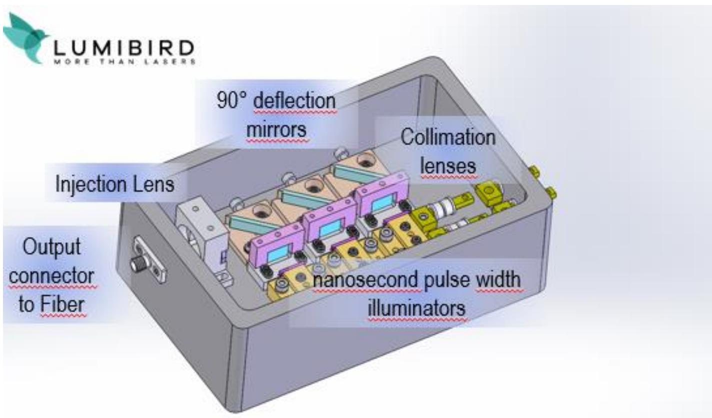
Urban scene



Urban scene with depth coded as false color



Urban scene coded in detected intensity
dark blue = faint signal
light blue = intense signal



Design Sketch of laser diode illuminators combined and packaged into fiber "pigtailed" module.

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Within the WP1 – consisting in Exploitation and Dissemination of the results obtained in each development WP, **ALTER** has prepared a dedicated workshop to cover Exploitation Plans contents and their update, as well as a webinar about CE Marking compliance. In addition, during this period, **ALTER** has initiated a normative analysis to identify what European Directives and standards are applicable to VIZTA project derived developments.

During this first year period, **ST** started a LinkedIn activity to promote participation of VIZTA project members to external conferences or events. During this period, **DFKI** participated in WACV '20 conference. **UPC** and **Beamagine** published an article ("An Overview of Lidar Imaging Systems for Autonomous Vehicles") on Appl. Sci. Journal.

Finally, **ST** assures a continuous project management with the support of **Ayming** (WP5). **ST** already co-organized three successful Executive Board (EB) meetings with the Kick-Off project meeting in June 2019, the 6M EB meeting at **III-V Lab** in Palaiseau, France (October 2019) and the 12M EB meeting via visio-conference (April 2020).

Summary

After 1-year activity, the VIZTA project and its consortium are fully operational and start to generate first outcomes in Technologies and Applications systems. The deliberate choice to gather complementary industrial actors across the supply-chain from equipment tools up to system OEMs with scientific support from academics and RTOs results in a dynamic collaborative spirit while addressing concrete exploitation targets.

Follow us to stay tuned for further news…

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