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ADOSE DELIVERABLE D3.8; PUBLIC SUMMARY
'PROTOTYPE OF MULTIFUNCTIONAL IMAGER'

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1. TARGET OF DEVELOPMENT

Workpackage 3 of ADOSE project develops a multifunctional and multispectral vision sensor aiming at integrating on a single CMOS array imaging and sensing functions. The goal is to detect critical environmental parameters (fog, rain, twilight) providing, at the same time, information on the driving scenario (oncoming vehicles, VRUs in night conditions) through the development of a low cost plastic optical lightguide coupled to a standard CMOS imager. In the developed prototyped, two sensing functions are monitored on two dedicated region of interests positioned in two corners of the imager area.

2. OPTOMECHANICAL PROTOTYPE ASSEMBLY

The prototype housing has been designed with the twofold goal of guaranteeing the required precision to couple the optics components and to pursue an easy to assembly procedure. The package is divided into two components, one coupled to the imager PCB and another one coupled to the former. The core optics component dealing with the optical channels have been fabricated in a pre-series moulding line using PMMA. Polycarbon has been used for the collimating optics of the infrared illuminator (fog function). The sensor housing has been prototyped by aluminum machining: the considered tolerances are compatible for the realization in production using PC.

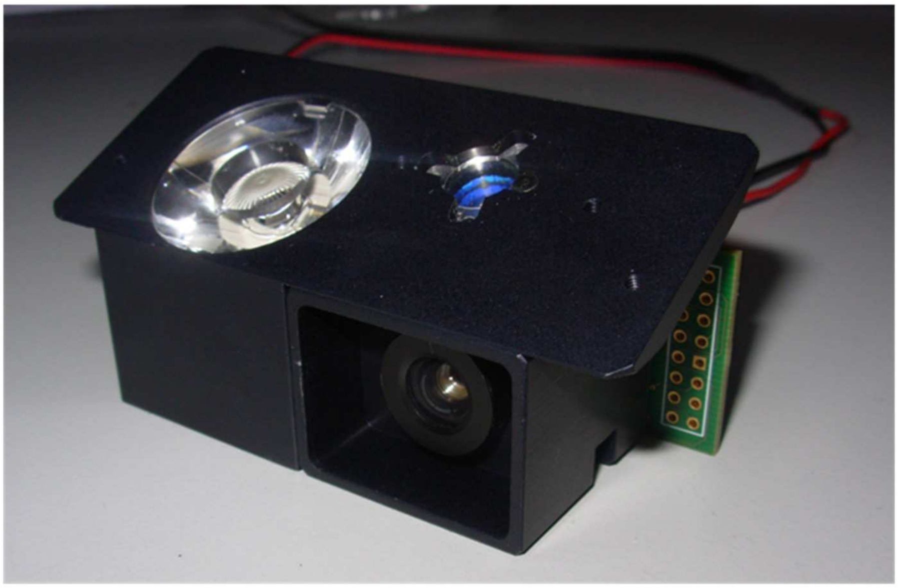

Figure 1: Assembled multifunctional imager prototype.

3. CHARACTERIZATION OF THE OPTICAL COMPONENTS

The characterisation of the optical components has been done for the plastic lenses and the optical objective. Moreover, tests have been carried out to evaluate the optical channels efficiencies and the spot dimensions of the assembled prototype. Curvature and roughness of plastic lenses have been measured as well as the emitting angular pattern of the infrared illuminator. A calibrated optical power meter has been used for the measurements of the optical channels efficiencies. By making differential measurements the transmission percentages have been figured out. The measured optical transmissions of the two optical channels are lower with respect to the simulated ones (due to the fabrication tolerances of the plastic optical components) and the twilight optical channel exhibits a better result due to the fact that the fog optical system is more complex than to the twilight one caused by aberrations.

Finally, the cross-talks among the region of interests and the measurement of the spot dimensions of the two optical channels have been evaluated. Results showed that a better focalisation than the twilight one characterized the fog function, particularly in the horizontal direction. In fact, an horizontal displacement of about 50 pixels due to the alignment of the imager and the lightguide has been measured.

4. CHARACTERISATION AT FUNCTIONAL LEVEL

The characterisation of the imager FOV has been done outdoor in order to take into account the in-vehicle sensor installation that could impact on the FOV positioning. The measured HFOV and VFOV were 40° and 20° respectivel y.

The position of the sensor with respect to the vehicle has been assessed by positioning target cones at several distances.

The twilight function has been characterized by measuring the region-of-interest mean values of the twilight optical channel as a function of the environmental illumination. Currently commercial sensors perform the measurement using a photodiode. Their operating range is up to 5Klx and they are calibrated to trigger the headlight switch on signal from 1500lx to 500lx, as preferred by the user. By setting the camera response in high-dynamic-range mode a calibration curve has been derived.

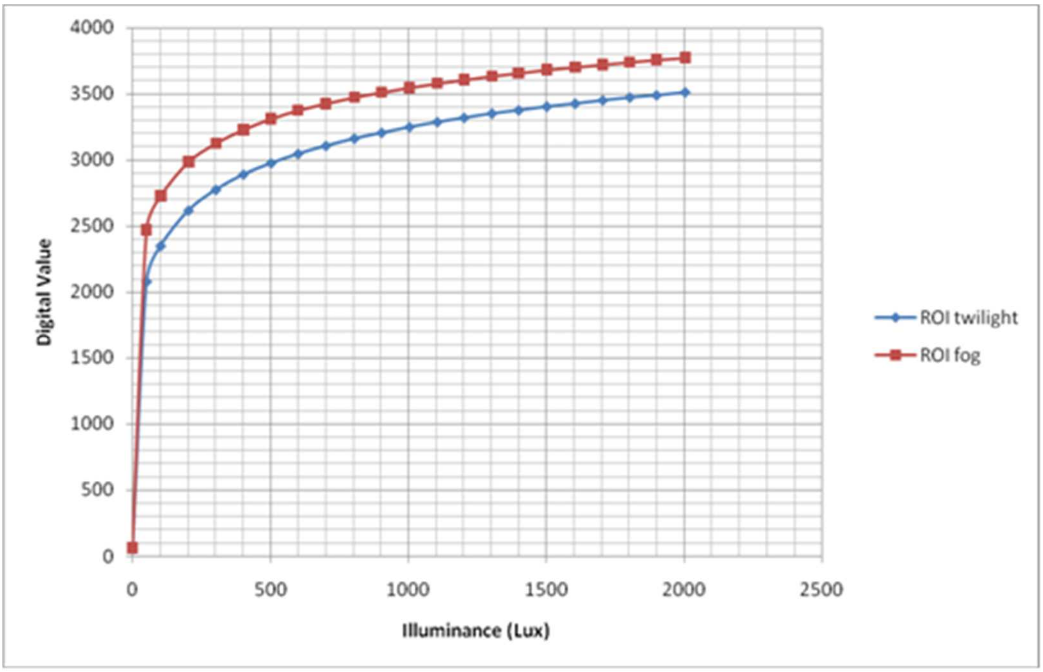

Figure 2: Twilight function calibration curves

The characterization activities related to the fog function consist of the calibration of the infrared optical output as a function of the driving current and the evaluation of the amount of backscattered radiation due to fog particles. A study aiming at the minimization of the infrared pulse duration has already been performed.

Preliminary acquisitions in real scenarios have been done for the tunnel/bridge. The aim of the function is to activate the low beams while approaching tunnels discriminating bridges for which no actuation has to be done. The first steps are to choose the right ROIs on the frontal view images to distinguish the tunnel presence, figure 3.

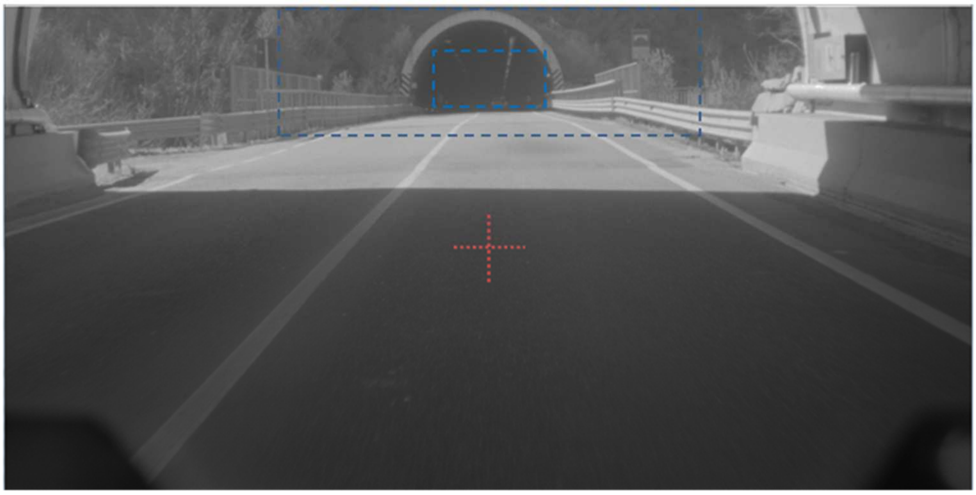

Figure 3: Image acquired in real scenario for the tunnel/bridge

Finally, a preliminary performance evaluation of the developed prototype for the warning night vision functions have been done. The infrared illuminators already installed on the prototype vehicle were characterised with respect to the emitting optical pattern. From the performed tests, the recognition of a pedestrian at 100m distance from the vehicle seems possible, figure 4.

Figure 4: Low beams and IR illuminators. Pedestrian at 100m