Comparative evaluation procedure – by qualifications and public debate – for the recruitment of one researcher with a fixed-term contract – in compliance with art. 24, paragraph 3, letter A) of L. no. 240 dated 30 December 2010- "Development of advanced technologies and systems for car safety via platform ADAS-ADAS+/co-funded by MIUR – PON R&I 2014-2020-ASSE II and by FSC" S.C. 09/G2 Bioengineering - S.S.D. ING-INF/06 Electronic Bioengineering and Information Technology - at the Department of Neuroscience Imaging and Clinical Science. <u>CUP. N. D96G18000190005</u>

Activity sheet and excerpt of Technical Specifications

With reference to the technical specifications of the project in question, the activities to be carried out by the winning candidate are described below.

<u>Summary of the project</u>

The ADAS+ project aims to develop an ***innovative demonstrator of safe driving assistance (ADAS+)*** capable of promptly and continuously monitoring the psycho-physical level of the driver, his state of intoxication and the quality of air inside the car. This will be achieved through the use of silicon technologies, advanced image processing algorithms and nano-structured materials incorporated into a common platform that meets the safe driving standards required for next-generation smart cars.

This goal will be pursued through the development and integration of three advanced prototype technological modules, based on the following innovative technological platforms:
• **Physio Module** consisting of miniature optic probes made of silica and based on SiPM (silicon photomultiplayer) technologies incorporated into the steering and capable of monitoring the level of attention (drowsiness) of the driver by continuously monitoring the heart rate and its variability.
• **Vision Module** consisting of (a) *visible light micro cameras* and (b) *IR light video cameras* to detect signs of fatigue or irritability, (c) *Radar/Lidar devices* made of silica for the recognition of obstacles   outside   the   car.
• **Chemical Sensors module** consisting of *a) Multichip with electric transduction to monitor the driver's level of sobriety/drunkenness* incorporated into the steering; *b) environmental sensor microchip to monitor the air quality inside the car* using nano-structured materials such as *Silicon NanoWires* and *MOx* (Metal Oxides).

These prototype modules will be integrated for the creation of a **final demonstrator of ADAS+ control unit** that will contain the ST components developed within the scope of the project and that will eventually be validated on the test vehicle.

<u>Activities for which the winning candidate is responsible</u>

The winning candidate will work, with his own original contribution and following the indications of the scientific manager of the project, on the following activities:

RI 1.2 Definition of High and Low Level Functional Specifications of the Vision Technology Module

This activity will be aimed at defining the high and low level functional specifications for the Vision technology module which includes the following components:

    a) Micro-camera with ambient light (car interior)
    (b) IR camera (car interior).

RI 3.1 Design and implementation of physiological probe hardware

On the basis of the functional specifications defined in RI1.2, this activity will be aimed at the design and implementation of the probe that provides information on driver awareness by monitoring specific physiological parameters in real time, to enhance the safety of driving.

RI 3.2 Design and implementation of smart algorithms for analysing physiological parameters

On the basis of the software specifications defined in RI1.1, the aim of this module is the creation of efficient, robust and automotive grade algorithms that allow the automatic monitoring of the driver (physiological and biometric parameters), the car interior and the driving dynamics. Using the data acquired (in real time) from the framework of physiological probes of the photopletismographic (PPG) and thermal signals, referred to in the previous RI, it will be necessary to reconstruct and monitor the driver's level of attention, in a non-invasive manner.

The algorithms developed will incorporate non-linear and innovative mathematical models closely related to physical and physiological phenomena, and machine learning and artificial intelligence systems (Artificial Neural Networks, SOM Self-Organising Networks, Convolutional Neural Networks (CNNs), Cellular Neural Networks, Fuzzy and Neuro-Fuzzy Systems, Genetic Algorithm, Autoencoders, etc.)....) in order to improve algorithm resistance to noise and disturbances of any kind, making it safer (according to automotive standards) and above all "adaptive". This will make it possible to have constant information on the driver's level of attention which, incorporated with the monitoring of his biomedical parameters, will enable the processing of appropriate corrective actions while driving.

RI 4.1 Design and implementation of advanced driver monitoring algorithms based on the use of visible light microcameras
Based on the functional specifications defined in RI1.2, this activity will be aimed at the design and implementation of advanced algorithms for monitoring the driver using visible light microcameras, focusing on the driver's behavioural aspects.

RI 4.2 Design and implementation of advanced driver monitoring algorithms based on the use of IR cameras

Based on the functional specifications defined in RI1.2, this activity will be aimed at the design and implementation of advanced algorithms for monitoring the driver using infrared thermal light cameras, as defined in RI3.2.

SS 7.1 HW and SW validation of the ADAS+ final demonstrator

This activity will be aimed at the HW and SW validation of the ADAS+ demonstrator.

SS 7.2 - In-car implementation of the ADAS+ technology demonstrator

This activity will be aimed at in-car validation of the ADAS+ demonstrator.

The winning candidate will be involved in all the experimental phases of data collection, acquisition and processing. An important contribution to the dissemination of the results of industrial research and experimental development is also expected.