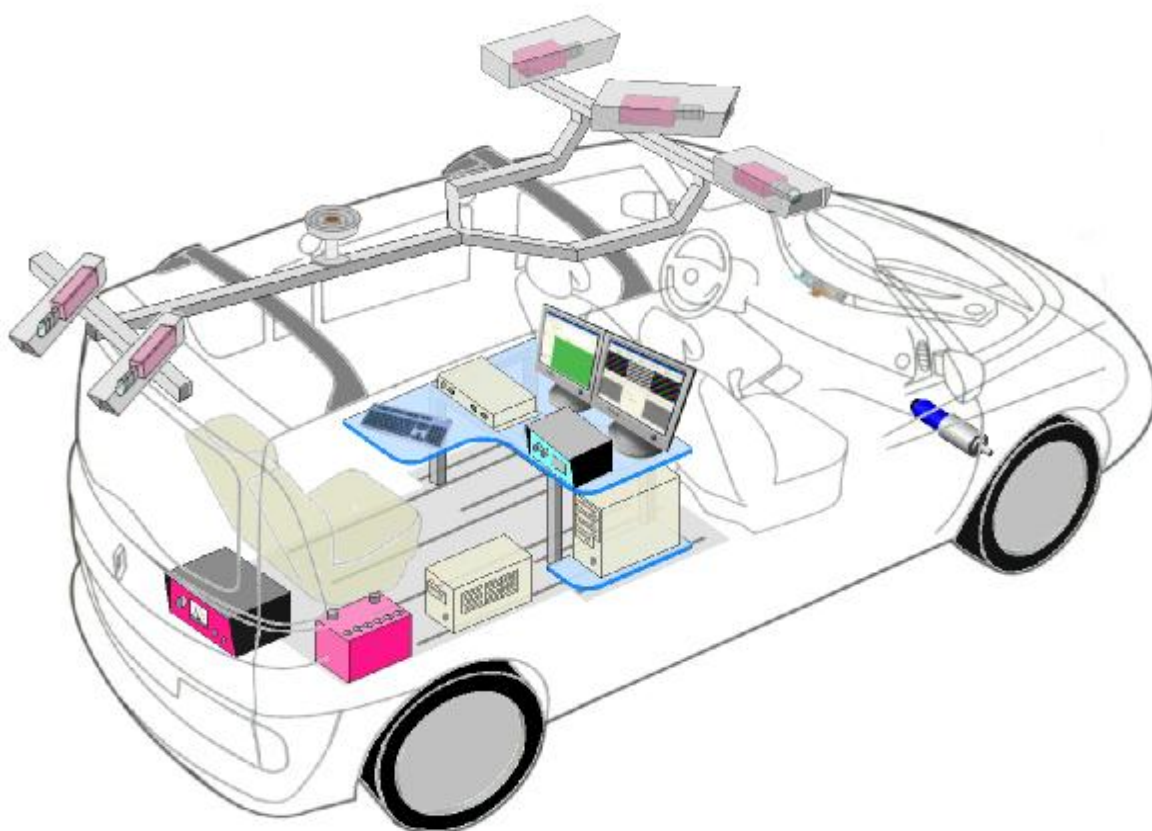# G.I.O.T.T.O. *S*

Gps Integrated with Odometer and Telecamera for Transport Optimization

PLAN OF A MODULAR SYSTEM FOR THE RELIEF TO HIGH RENDERING FOR THE ROADS

(MODULAR MOBILE MAPPING SISTEM FOR HIGH EFFICIENCY ROAD SURVEYS)

OUR PROFILE

CeraIngegneria is a young society, born in 2002. The aims of Luciano Cera, its founding member, was to apply his studies and the academic researches in the fields of the planning and management of road infrastructures. All the society activities are technology-driven and at now there are various partnerships with professionals and universities. CeraIngegneria aims to be present in the European scenario, in the fields of transport engineering and mobility management.
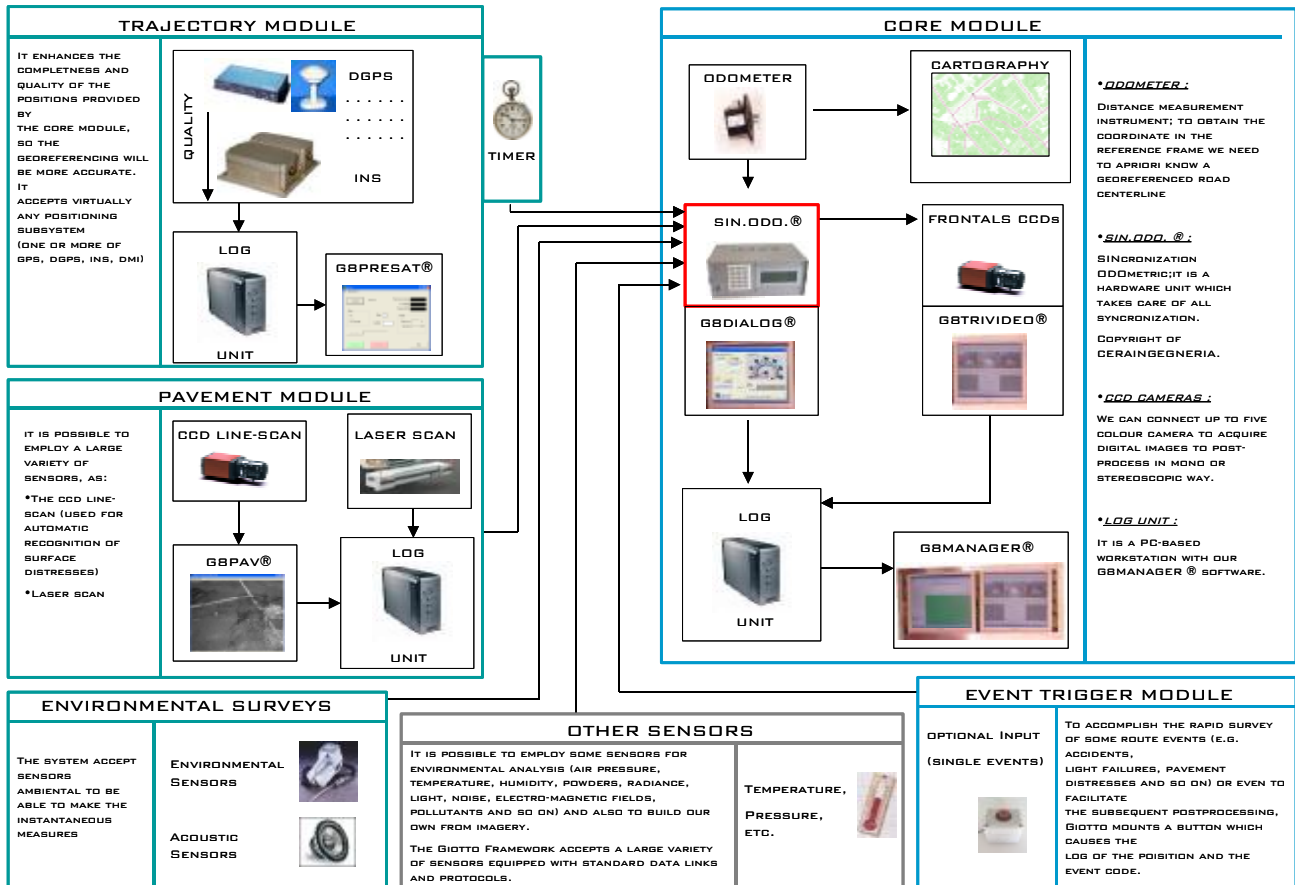
WHAT IS A MOBILE MAPPING SYSTEM (MMS)

A *terrestrial* Mobile Mapping System is in essence a car equipped by a system of computers and sensors (typically, Global Positioning Systems receivers, Inertial Measurement Units, Distance Measurement Interfaces, CCD cameras, lasers and lidars) which is able to provide and store all the sensors data (typically, imagery data) together with the position of the car at the time of the sensor output. In brief, a MMS is a mobile system able to provide *georeferenced data* which are typically used to make maps.

The performance of a MMS derives essentially from the accuracy of the positional solutions, from the quality and the number of the images taken and from the accuracy of the georeference model.

A simple MMS is equipped at least with a positional subsystem and a video subsystem. All the images taken by the second subsystem are associated with a position derived by the first subsystem. All the georeferenced images will be processed (typically, by softwares with photogrammetric and classification capabilities) in order to derive the informations of interest in the subsequent phase of map making. In the case of a road survey some information of interest are: the lanes width, the road sign positions, the kind and the conditions of the pavement and so on.

The MMS technology developed by CeraIngegneria is *modular*. Our architecture is defined by some *independent* functional subsystems (see figure above), which can be implemented with variables grades of accuracy and complexity. The heart of the system is the integration component (Sin.Odo, see later). The system components are:

1. a trajectory subsystem, at least a (D)GPS receiver with dead reckoning capabilities, optionally an Inertial Measurement Unit and a Distance Measurement equipment.
2. a video subsystem, up to five CCD (digital cameras) or other kinds of cameras.
3. one or more non-video sensors subsystems (laser, lidar, pollution sensors and so on).
4. a synchro equipment (Sin.Odo.®, *sincronizzatore odometrico*) which triggers the cameras and the other sensors. The synchronization process can be driven by distance information or time information derived from the trajectory subsystem. This is a *hardware* component.
5. a monitoring subsystem (based upon our software G8MANAGER®) which takes care of the overall reliability and logs all the mission data:

    *   trajectory subsystem (based our subsystem software G8PRESAT®)
    *   video subsystem (based our subsystem software G8TRIVIDEO®)
    *   synchro equipment (based our subsystem software G8MANAGER®)

TRAJECTORY MODULE

It enhances the completness and quality of the positions provided by the core module, so the georeferencing will be more accurate. It accepts virtually any positioning subsystem (one or more of gps, dgps, ins, dmi)

QUALITY

DGPS

INS

LOG UNIT

GBPRESAT®

TIMER

CORE MODULE

ODOMETER

CARTOGRAPHY

SIN.ODO.®

GBDIALOG®

FRONTALS CCDs

GBTRIVIDEO®

LOG UNIT

GBMANAGER®

*ODOMETER :
Distance measurement instrument; to obtain the coordinate in the reference frame we need to apriori know a georeferenced road centerline

*SIN.ODO. ® :
SINcronization ODOmetric;it is a hardware unit which takes care of all syncronization. Copyright of CERAINGEGNERIA.

*CCD CAMERAS :
We can connect up to five colour camera to acquire digital images to post-process in mono or stereoscopic way.

*LOG UNIT :
It is a PC-based workstation with our GBMANAGER ® software.

PAVEMENT MODULE

It is possible to employ a large variety of sensors, as:
*The ccd line-scan (used for automatic recognition of surface distresses)
*Laser scan

CCD LINE-SCAN

LASER SCAN

GBPAV®

LOG UNIT

ENVIRONMENTAL SURVEYS

The system accept sensors ambiental to be able to make the instantaneous measures

Environmental Sensors

Acoustic Sensors

OTHER SENSORS

It is possible to employ some sensors for environmental analysis (air pressure, temperature, humidity, powders, radiance, light, noise, electro-magnetic fields, pollutants and so on) and also to build our own from imagery.
The Giotto Framework accepts a large variety of sensors equipped with standard data links and protocols.

Temperature, Pressure, etc.

EVENT TRIGGER MODULE

optional Input (single events)

To accomplish the rapid survey of some route events (e.g. accidents, light failures, pavement distresses and so on) or even to facilitate the subsequent postprocessing, Giotto mounts a button which causes the log of the posision and the event code.

GIOTTO PROJECT: PROTOTYPE REALIZATION

(**G**ps **I**ntegrated with **O**dometer and **T**elecamera for **T**ransport **O**ptimization)

GIOTTO (Gps Integrated with Odometer and Telecamera for Transport Optimization), is a Cera Engineering project about an innovative system of cartographic mobile laboratory (Mobile Mapping System) for the high-efficiency relief of the roads and of his pertinences. It has been conceived to be adapted in urban areas and generally for situations in which visibility by the satellite is low.

The operational principle is structured to allow the choice between two kind of synchronizations of the internal sensors: odometrical (from which the name SIN.ODO.) or time information (with GPS).

GIOTTO, a system that can be reproduced and extended, has been elaborated by the Research & Development area of the CERA INGEGNERIA thanks, also, to a financing funds of the Abruzzo Region and in collaboration with research centres and universities. GIOTTO is a project that aims to realize a mobile mapping system prototype for the high-efficiency road surveys.

The Giotto base technology foresees coordinated systems :

➢ a **trajectory** subsystem to identify the vehicle position;

➢ video sensors of the images to provide and store the territorial database;

➢ environmental sensors for the pollution constant monitoring;

➢ optional inputs for monitoring several kind of events;

- ➢ synchronization process able to provide georeferenced images (on the distance and/or the time) and, in general, all the sensors;
- ➢ control and monitoring of the information for corrections in real time;
- ➢ feeding in order to supply tension to the internal equipment.

The technical characteristics of the systems that are part of the vehicle are described below:

Trajectory system:

- ➢ hardware system Dead Reckoning (DR) based on piezoelectric sensors;
- ➢ GPS receiver of 8 channels, L1 frequency, precision of non –differential point =15 m, precision on the point with DR= 8 m.

Video system:

- ➢ Up to n. 5 CCD high resolution 1280x960 color cameras, frequency of acquisition 15 fps, horizontal position regarding trajectory
- ➢ : 0° frontal sight, +/- 45° oblique sight, +/- 90° lateral sight
- ➢ n. 2 CCD b/w back Cameras oriented to acquire information on the road pavement;
- ➢ software owner G8MANAGER for the management of the video system;
- ➢ Synchronization System;
- ➢ "SIN.ODO. Odometric Synchronization" (CERA INGEGNERIA Copyright) composed from a synchronization unit of the photogrammetric surveys with the impulses of odometric signal;
- ➢ G8MANAGER software in order to control and monitoring the video system and the trajectory subsystem.

Control system and monitoring:

- ➢ 2 workstation with Pentium 4 processor;
- ➢ monitor LCD 19 inches;
- ➢ notebook, Pentium IV processor, Clock 2,4 GHz, Ram 256 MB.

PROTOTYPE
REALIZATION :

GIOTTO SYSTEM
INSTALLED
ON RENAULT ESPACE