# Ground Control Point - Wireless System Network for UAV-based environmental monitoring applications

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In recent years, Unmanned Aerial Vehicles (UAV) have seen widespread civil applications including usage for survey and monitoring services in areas such as agriculture, construction and civil engineering, private surveillance and reconnaissance services and cultural heritage management.

Most aerial monitoring services require the integration of information acquired during the flight (such as imagery) with ground-based information (such as GPS information or others) for improved ground truth validation. For example, to obtain an accurate 3D and Digital Elevation Model based on aerial imagery, it is necessary to include ground-based information of coordinate points, which are normally acquired with surveying methods based on Global Position Systems (GPS). However, GPS surveys are very time consuming and especially for longer time series of monitoring data repeated GPS surveys are necessary. In order to improve speed of data collection and integration, this work presents an autonomous system based on Waspmote technologies build on single nodes interlinked in a Wireless Sensor Network (WSN) star-topology for ground based information collection and later integration with surveying data obtained by UAV. Nodes are designed to be visible from the air, to resist extreme weather conditions with low-power consumption. Besides, nodes are equipped with GPS as well as Inertial Measurement Unit (IMU), accelerometer, temperature and soil moisture sensors and thus provide significant advantages in a broad range of applications for environmental monitoring. For our purpose, the WSN transmits the environmental data with 3G/GPRS to a database on a regular time basis. This project provides a detailed case study and implementation of a Ground Control Point System Network for UAV-based vegetation monitoring of dry mountain grassland in the Matsch valley, Italy.