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A Cloud Robotics Based Service for Managing RPAS in Emergency, Rescue and Hazardous Scenarios

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Cloud robotics and cloud services are revolutionizing not only the ICT world but also the robotics industry, giving robots more computing capabilities, storage and connection bandwidth while opening new scenarios that blend the physical to the digital world. In this vision, new IT architectures are required to manage robots, retrieve data from them and create services to interact with users.

Among all the robots this work is mainly focused on flying robots, better known as drones, UAV (Unmanned Aerial Vehicle) or RPAS (Remotely Piloted Aircraft Systems).

The cloud robotics approach shifts the concept of having a single local "intelligence" for every single UAV, as a unique device that carries out onboard all the computation and storage processes, to a more powerful "centralized brain" located in the cloud. This breakthrough opens new scenarios where UAVs are agents, relying on remote servers for most of their computational load and data storage, creating a network of devices where they can share knowledge and information.

Many applications, using UAVs, are growing as interesting and suitable devices for environment monitoring. Many services can be build fetching data from UAVs, such as telemetry, video streaming, pictures or sensors data; once. These services, part of the IT architecture, can be accessed via web by other devices or shared with other UAVs. As test cases of the proposed architecture, two examples are reported.

In the first one a search and rescue or emergency management, where UAVs are required for monitoring intervention, is shown. In case of emergency or aggression, the user requests the emergency service from the IT architecture, providing GPS coordinates and an identification number. The IT architecture uses a UAV (choosing among the available one according to distance, service status, etc.) to reach him/her for monitoring and support operations. In the meantime, an officer will use the service to see the current position of the UAV, its telemetry and video streaming from its camera. Data are stored for further use and documentation and can be shared to all the involved personal or services.

The second case refer to imaging survey. An investigation area is selected using a map or a set of coordinates by a user that can be on the field on in a management facility. The cloud system elaborate this data and automatically compute a flight plan that consider the survey data requirements (i.e: picture ground resolution, overlapping) but also several environment constraints (i.e: no fly zones, possible hazardous areas, known obstacles, etc). Once the flight plan is loaded in the selected UAV the mission starts. During the mission, if a suitable data network coverage is available, the UAV transmit acquired images (typically low quality image to limit bandwidth) and shooting pose in order to perform a preliminary check during the mission and minimize failing in survey; if not, all data are uploaded asynchronously after the mission. The cloud servers perform all the tasks related to image processing (mosaic, ortho-photo, geo-referencing, 3D models) and data management.