**Documentation for Quad-eye Project**

* **Data sources:**

Data for processing the areas that are in risk of fire are obtained from the service provided by EFFIS (European Forest Fire Information System), which is an European agency in charge of protection services against fires in EU countries (<http://effis.jrc.ec.europa.eu/>). From this service, up to date information is obtained from the actual season of forest fire risks in Europe, such as the forecast for the next six days, daily updating the main areas of risk and the perimeters of the dangerous zones. For the gathering of data, the EFFIS makes use of the information which NASA’s satellites provide: *MODIS (*<https://modis.gsfc.nasa.gov/>*)* and *VIIRS (*<https://earthdata.nasa.gov/earth-observation-data/near-real-time/firms/viirs-i-band-active-fire-data>*).* Web services: <http://gwis.jrc.ec.europa.eu/rest/>

The central server carries out a data request to the web service every certain time through an Internet connection, extracting, from the data structure the following points:

* + **Latitude / longitude:** Geospatial coordinates in a decimal format. Generally, there will be a set of coordinates that define a region (polygon).
  + **Frequency of information updates:** Time that passes by after each data update.
  + **Risk percentage:** Risk of fire probability in each region, being 0% the lowest risk and 100% the highest risk.
  + **Fire:** Determines if in any specific coordinates there already exists an active fire.

Due to the low resolution of the data that this API provides us, or in case that it is disabled or does not function how it should, we proceed to extract data from an alternative source, which consists in two phases:

* Data in low resolution from a fire risk index (FWI), extracted from [*ftp://ftp.nccs.nasa.gov*](ftp://ftp.nccs.nasa.gov)and [*https://data.giss.nasa.gov/impacts/gfwed/*](https://data.giss.nasa.gov/impacts/gfwed/) *.* This index is extracted from “Canadian Wildland Fire Information System” ([*http://cwfis.cfs.nrcan.gc.ca/background/summary/fwi*](http://cwfis.cfs.nrcan.gc.ca/background/summary/fwi)). Depending on the factor of risk in the zone, will leave more or less frequently, and will examine the zone in a more exhaustive way or not.
* Due to the low spatial resolution, the risk zone is too large for sampling with the drones, thus it is necessary to cross with other data. In this case, the NDVI’s index of vegetation is used, extracted from LandSat 8, in such way that the total area left to explore decreases considerably.
* **Processing and storage of data:**

The information extracted will be stored in a database for its processing. Previously, it will proceed to the real-time calculation routes, which are then sent to the drones, so these are able to monitor the regions where there is a higher risk of a fire, or otherwise, to regions which have already been burnt.

To proceed the calculation there are several variables that are needed:

* + Environmental conditions (for instance, probability of rain).
  + Probability of a fire in the region (if the probability is high, there will be a higher-frequency of monitoring).
  + Geospatial coordinates of the regions with fire probability, for the calculation of most efficient routes.
* **Drone take-off:**

The drones have a permanent double-direction communication through a GSM connection, which provides new routes at the same time when these have already been calculated and when the drone is not functioning (on earth). At the same time, the drone is sending data related to its state (operative or not functional), as well as useful data in a situation that the fire was detected.

* **Optimization journey algorithm:** It will optimize the route previously sent, calculating the necessary height, that together with the vision angle of the camera, it will manage to capture the biggest terrain possible without the need of the drone displacing.
* **Processing of images with infrared camera for fire detection algorithm:** This algorithm precisely determines whether the infrared camera has detected fire in the images that are projected. (http://journals.sagepub.com/doi/full/10.1155/2014/597368 )
* **Data summary proceeding from the drone:** In case that there is a fire detected through the infrared camera, the drone send useful data, such as the direction and strength of the wind, temperature, humidity, geospatial coordinates, visible-light images…
* **Web application:**

Throughout the web portal, all the users and the public will have access to updated information about the fire situation of their region in real-time.

The web application will show all the data stored by the drones during its monitoring (previously described), as well as maps with geolocations of the risk zones and active fires.

The users could subscribe to the system in order to be notified and alerted of the fires, which are active near them.

If the user accesses web portal throughout a cell phone which has an active GPS, it will display the risks in their range of movements and actions.

Apart from this, the user will be provided additional information about the action protocol in case of fire, so that people are prepared.