Monitoring regattas with drones

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Group 6
Project in Informatics

Context

A regatta is a nautical race between several boats doing a course marked by buoys.

Due to the nature and context of regattas, in many cases the referee's job of enforcing the rules is difficult, which compromises the integrity of the race.

This project hopes to support the referee in making correct calls by giving him all the data he requires.

Race start problem

All boats must stand behind the line at the moment of the start of the regatta. The starting line is delimited by a buoy and a boat with a signaling pole, from where the referee verifies if the line is being crossed.

There are two main problems:

Boat identification.

Referee has no clear vision of all boats.

Buoy problem

The race's course is marked by buoys that the boats have to cross and turn at. Touching each other or the buoy is against the rules.

The referee watches from afar, and can't properly see what is happening.

Boat recording

Being capable of recording a boat’s maneuvers and its pathing is something important for training for a regatta.

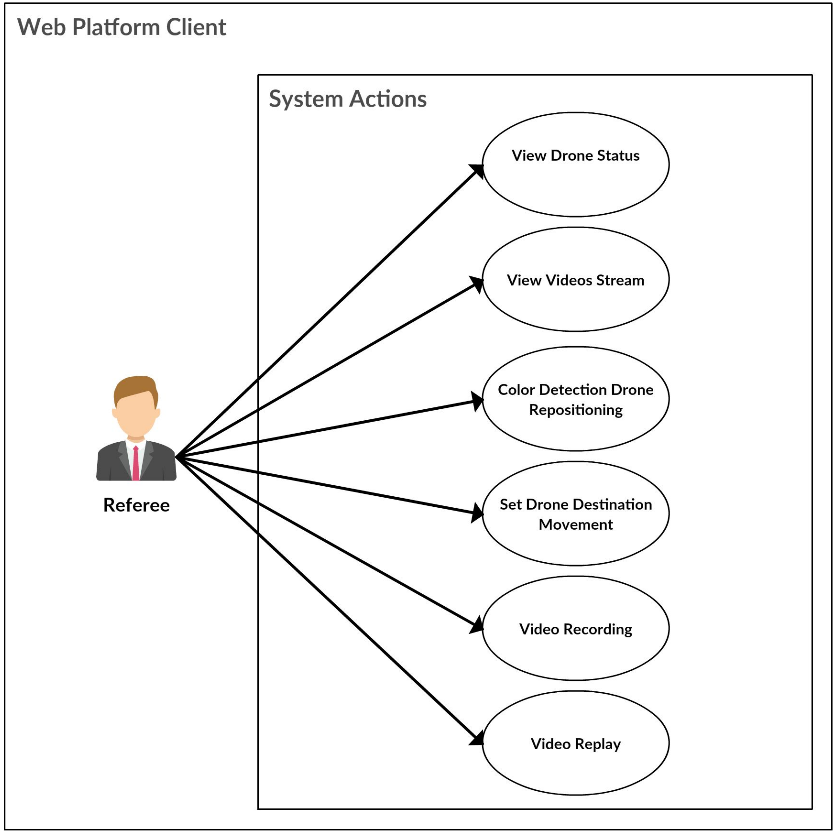
However in the environment it happens it can be difficult to do such.

Solution

A system capable of tracking every boat, providing video from a vantage point and capable of recording it.

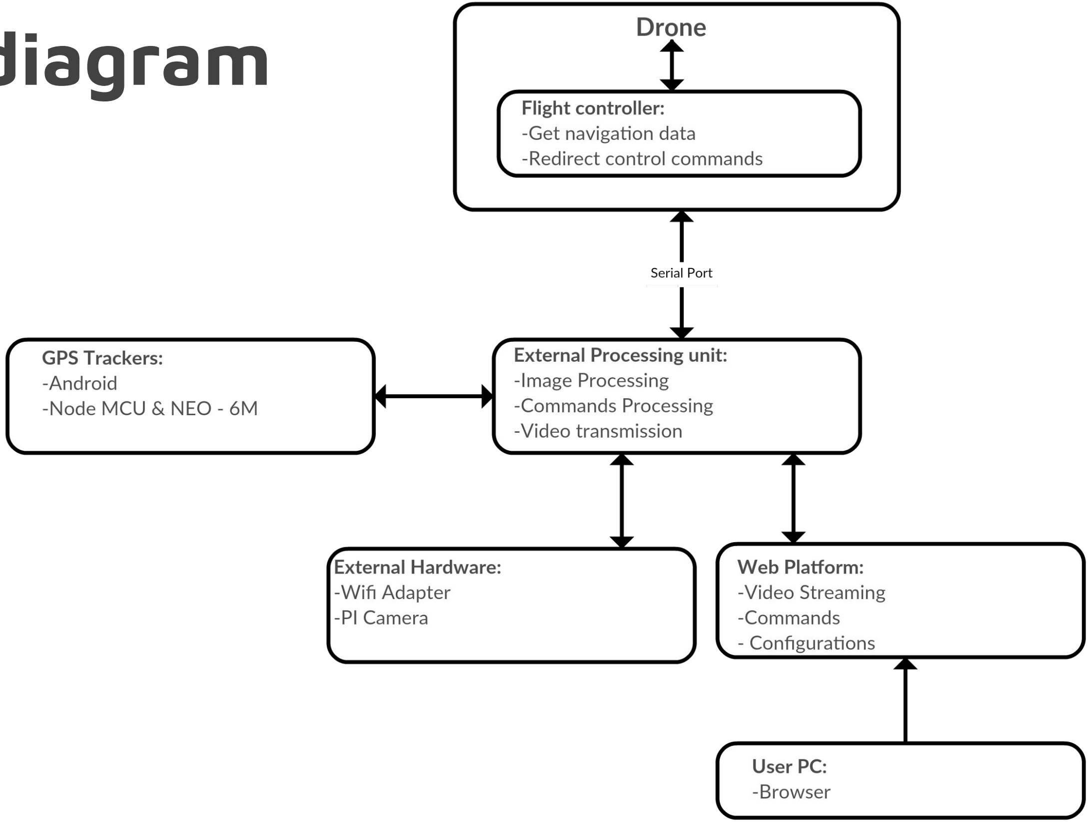
Accomplished by using a drone for video recording and a intuitive interface for the user to check all the regatta information.

Use cases

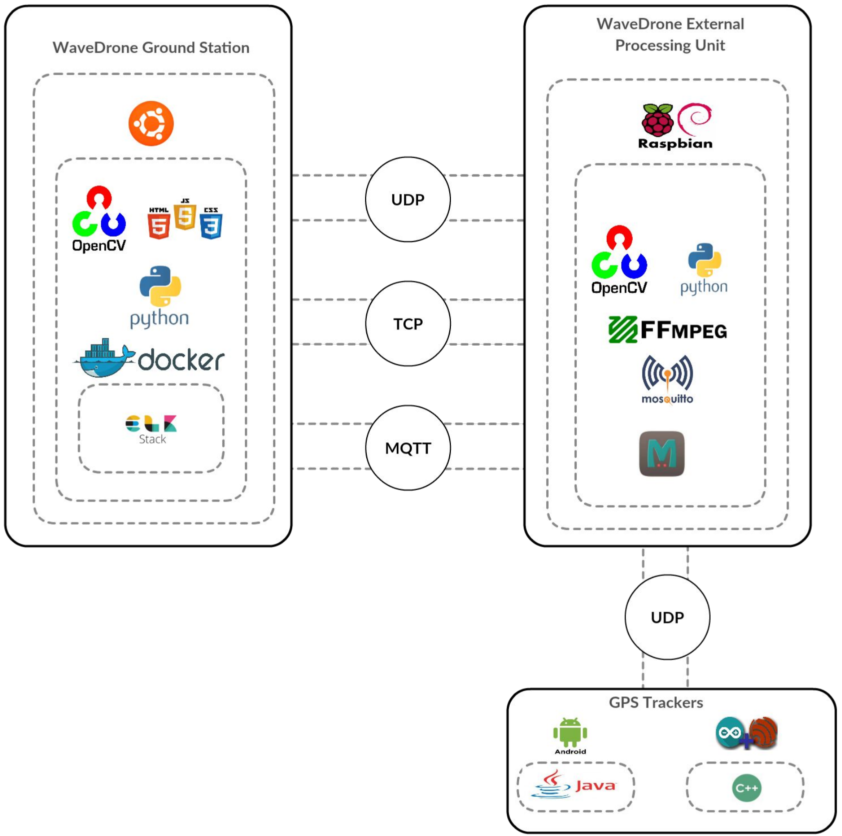


Web Platform Client
System Actions
Referee
View Drone Status
View Videos Stream
Color Detection Drone Repositioning
Set Drone Destination Movement
Video Recording
Video Replay

Hardware diagram



Software diagram

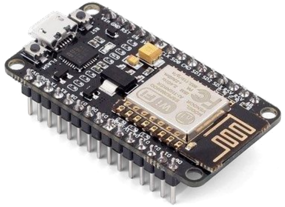


Gps trackers

An android application was developed that sends GPS and orientation data through a UDP socket.

A nodeMcu was flashed with code to retrieve GPS data from a Ublox NEO-6M and send it through the same UDP socket.

Both send new data every two seconds.



Drone

Drone data and commands

No API or library for drone communication available,

All communication with the INAV controller made via serial using the MSPv2 messaging protocol

Need to implement the drone communication logic ourselves.

Drone communication - solution

Single communication endpoint permanently connected to the FC.

Available on demand to all modules residing within the RPI.

Issues commands to the FC and returns the response

Prepared to send and receive any available commands.

Manages concurrent accesses.

Automatic message parsing based on message type.

GPS location to image position

In order to place the the boats' identifiers over the video stream correctly, it is needed to calculate an estimate of their position on the image received.

This module calculates the expected image position for an array of boats using their given gps position and the drone's data. The parameters of dronedata necessary are it's gps position, compass orientation, x and y inclination angles and height.

Image position to GPS conversion

This module calculates the gps position of a given buoy using it’s position on the camera image and the drone data.

The buoy’s image position is calculated beforehand using the image detection module.

The gps location obtained is used to adjust the drone’s position over the buoy.

Video

Video is one of the main assistance that our system provides to the referee. It provides 3 mains types of video.

Real-time digital video

Real-time analog video

Digital video recordings

Real Time Video

Analog:

Front-mounted FPV camera

Resolution: 976x582 Framerate: 25 fps

Uses a dedicated transmitter and receiver working on 5,8 Ghz frequencies

Digital:

Raspberry Pi Camera Module

Resolution: 854x480 Framerate: 15 fps

The video is encoded in h264 and transmitted over wifi

Video Storage

Video recordings can be made with the digital camera when requested by the user.

Recorded videos stay in the drone.

Recordings can be processed and transferred to the Groundstation from the interface.

Settings can be configured.

Buoy recognition

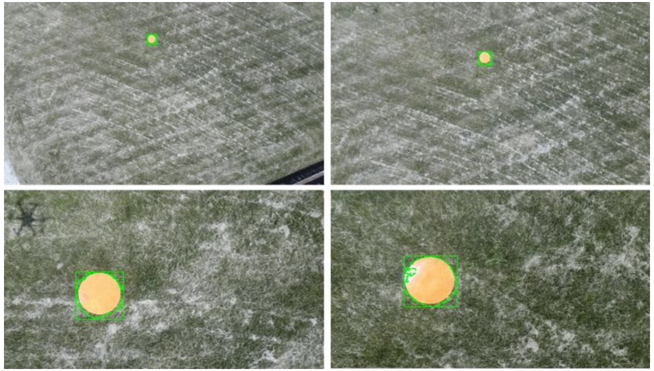
To create a better GPS position to center the drone on the buoy we used image recognition.

A OpenCV color detection algorithm was applied.

The HSV parameters for the mask are defined in the interface before the recognition.

The center position is found and used to calculate a new GPS position.

The drone is then sent to this new position.



Future work

Autonomous flight tests

Network stability tests

Stress tests

Acknowledgments

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