

# The Paparazzi Platform

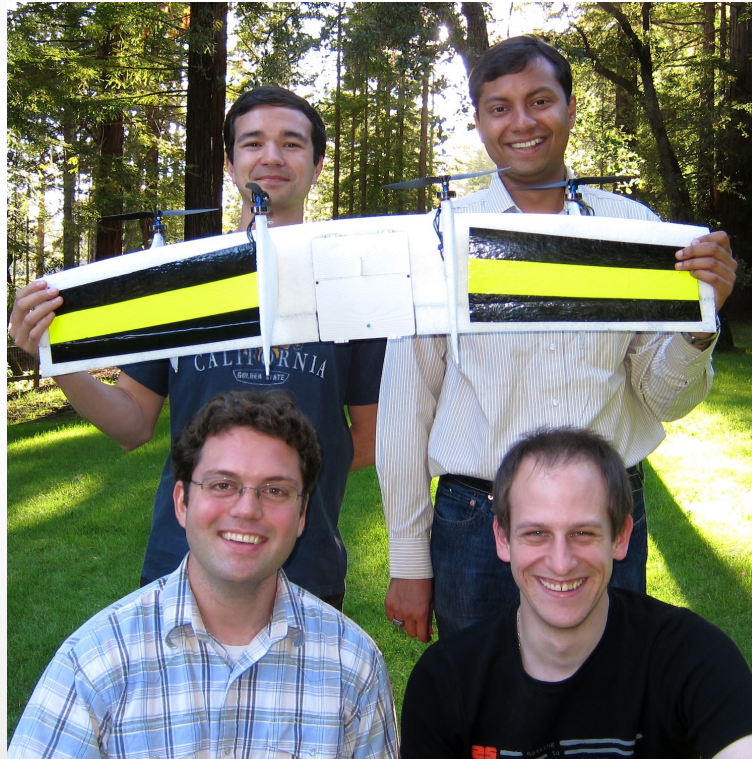
Flexible, Open-Source, UAS Software and  
Hardware

esden, dotAero, misterj, cifo

# Outline

- History, User Community, Competitions & Missions
- Software
- Hardware
- Example Vehicles
- Demos

# Who are we?



# Who is Paparazzi?

Micro unmanned aerial vehicle framework



<http://paparazzi.enac.fr>

# Why do I care?

We're not going to preach the advantages of autonomous or RC vehicles - you know this already.

Paparazzi:

- Innovative
- Competitive
- Hugely flexible

"Many start Paparazzi as UAV hobbyists and leave as professionals!"

# History

The journey started in 2003



Pascal Brisset & Antoine Drouin

# History

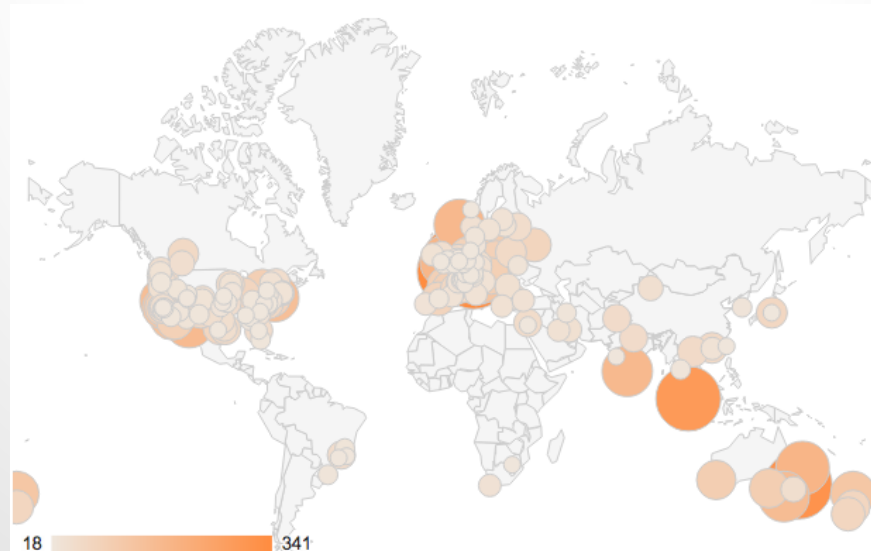
Ecole Nationale de l'Aviation Civile



Toulouse, France

# History

Over 60 developers contributing code  
several hundred users from 18 countries and  
counting





# Involved Universities



Delft University of Technology



# Competitions

- JMD03, Toulouse, France : 1st place with the Twinstar
- EMAV04, Braunschweig, Germany : 1st place with the Microjet
- JMD04, Toulouse, France : 1st place with the Microjet
- MAV05, Garmisch, Germany : 4 Paparazzi teams at the first 4 places
- EMAV06, Braunschweig, Germany : all the teams were equipped with Paparazzi
- MAV06, Sandestin, Florida : 2nd and 3rd places
- MAV07, Toulouse, France : 1st place (tie), 3rd, 4th and 5th places
- OC09, Queensland, Australia : 1st place robot airborne delivery challenge
- IMAV2011, Harde, Netherlands : 2nd place outdoor challenge
- DARPA UAVForge 2011-12 : 3rd place

# Missions

2011 Antarctica Finnish Meteorological Institute



# Missions

2012 Southern Madagascar multi university



# Software - Overview

- Airborne and Ground Segments
- Reconfigurable multi-agent system, small programs perform simple tasks



# Software - Ground Segment

The screenshot displays the GCS (Ground Control Station) software interface. The main window is titled "GCS" and shows a 2D map of an aerial view with various flight paths and waypoints. The map is labeled "2D Map" in red text. Below the map are two status panels for aircraft TJ1 and MI2, a Notebook, and a Console.

**2D Map**

**TJ1 Status Panel:**

00:00:35	11.6ms	83%	Standby
Bat	Status	AGL	Block
12.5	AUTO2	67	Time 00:26
NONE	NONE	+0.1	Stage 00:26
Link	3D	/Target	ETA N/A
		-6m	Alt 254m / 260m

**MI2 Status Panel:**

00:00:28	12.1ms	58%	Standby
Bat	Status	AGL	Block
12.5	AUTO2	62	Time 00:22
NONE	NONE	+0.0	Stage 00:22
Link	3D	/Target	ETA N/A
		-11m	Alt 249m / 260m

**Notebook:** A circular gauge showing altitude and other parameters. The gauge has a scale from 0 to 20 on the top half and -10 to -20 on the bottom half. The needle is pointing to approximately 12.1.

**Console:** A log of system events:

- 13:46:59 TJ1, UNK
- 13:46:59 TJ1, mayday, kill mode
- 13:47:01 MI2, AUTO2
- 13:47:01 TJ1, AUTO2
- 13:47:01 MI2, mayday, kill mode
- 13:47:02 MI2, Geo init
- 13:47:04 TJ1, Holding point
- 13:47:11 MI2, Holding point
- 13:47:58 TJ1, Takeoff
- 13:48:05 MI2, Takeoff
- 13:48:07 TJ1, Standby
- 13:48:11 MI2, Standby

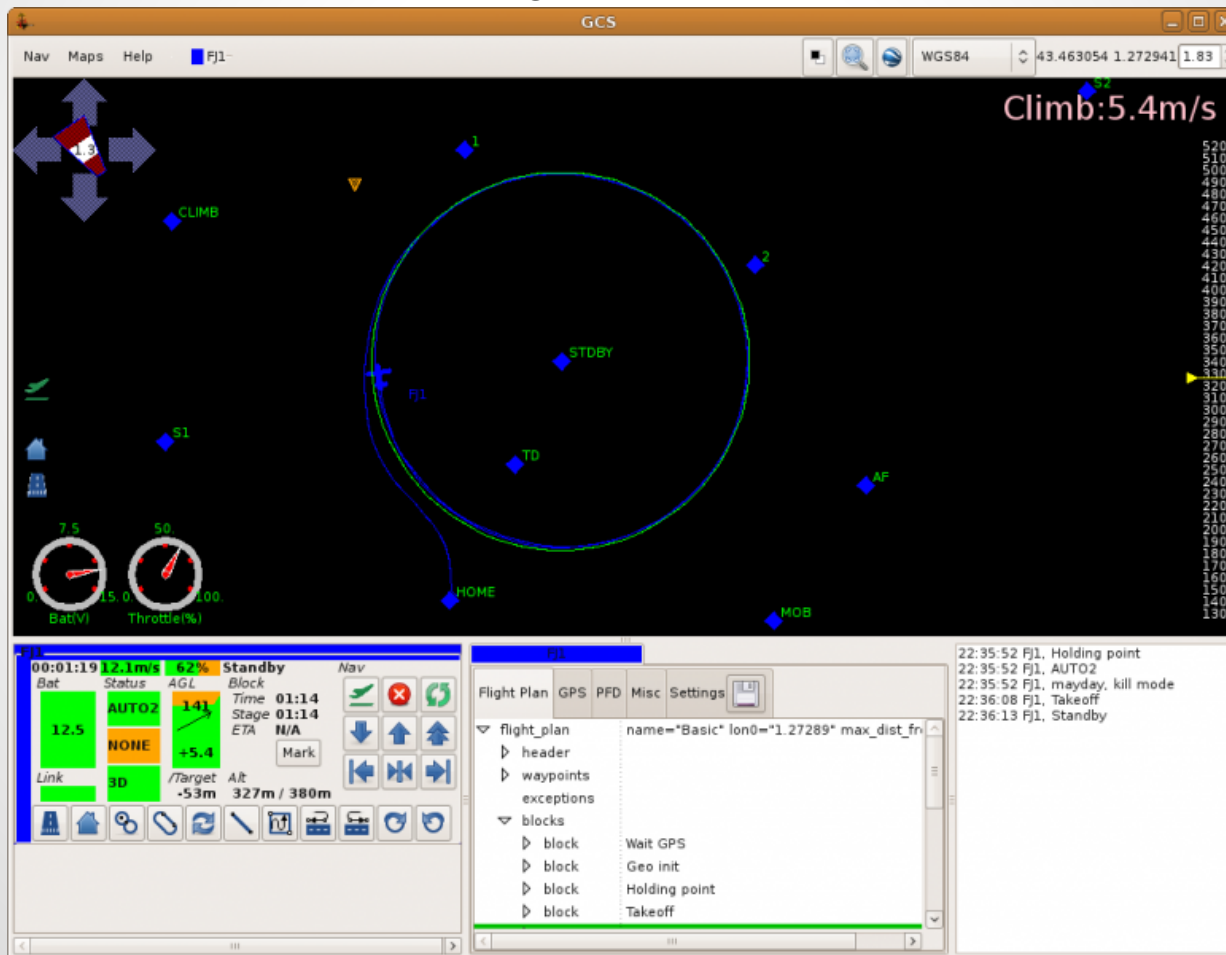
**Strips**

**Notebook**

**Console**

# Software - Ground Segment

## Reconfigurable UI (XML)





# Software - Airborne Segment

- Modules allow easy addition or replacement of functionality
- Supports a multitude of sensors and actuators
- XML-based automatic code generation allows quick code adaptation for different vehicle configurations

# Software - Airborne Segment

- Complementary and Kalman filter-based estimators
- PID, PID with FF and adaptive controllers for attitude, altitude and position control

# Software - License



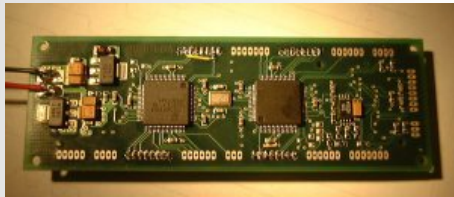
<http://paparazzi.github.com>

# Software - Demo

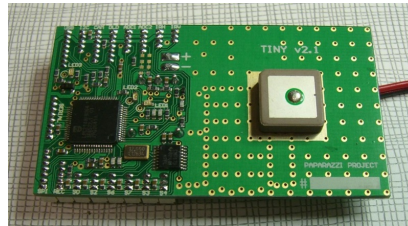
- Flight in simulator
- Pray to Demo Gods

# Hardware - Overview

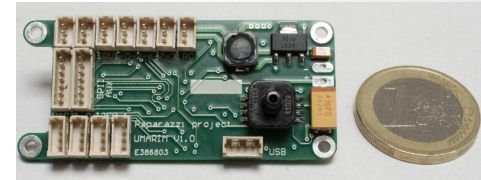
Classix  
ARM7



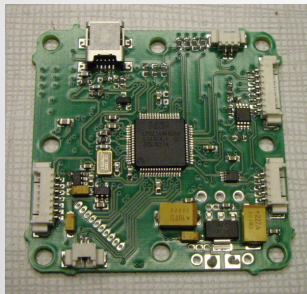
Tiny  
ARM7



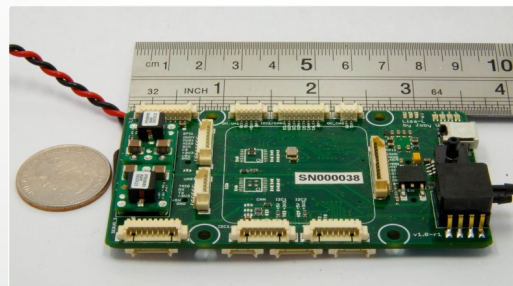
Umarim  
ARM7



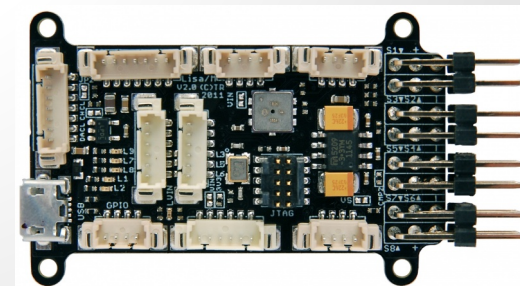
Booz  
ARM7







Lisa/L  
ARM Cortex-M3  
ARM Cortex-A8



Lisa/M  
ARM Cortex-M3



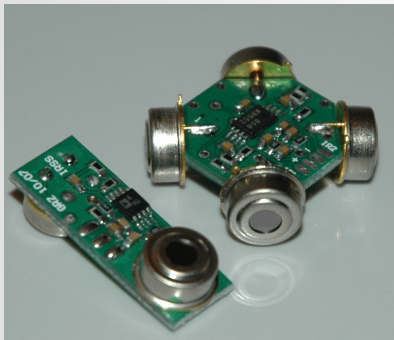
# Hardware - Architectures

-  Atmega 8MHz (Dropped 2010)
-  7 TDMI 60MHz (Stable)
-  -M3 72MHz (Stable)
-  -M4 168MHz+DSP (Upcoming)

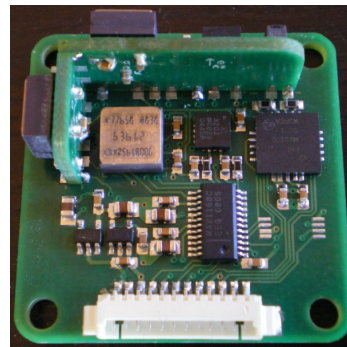
# Hardware - Sensors

Developed by the Paparazzi Community OSHW

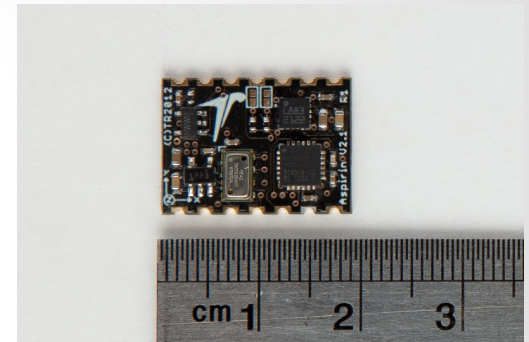
IR Sensor



Booz IMU

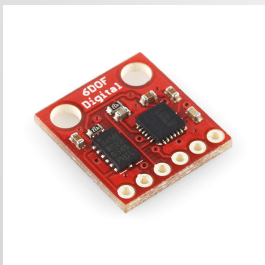


Aspirin IMU



Third party hardware

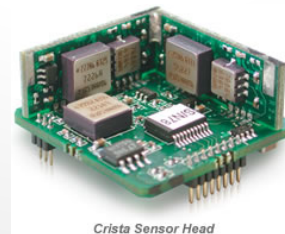
Sparkfun IMU



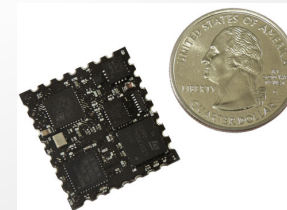
Polulu IMU



Cloudcap IMU



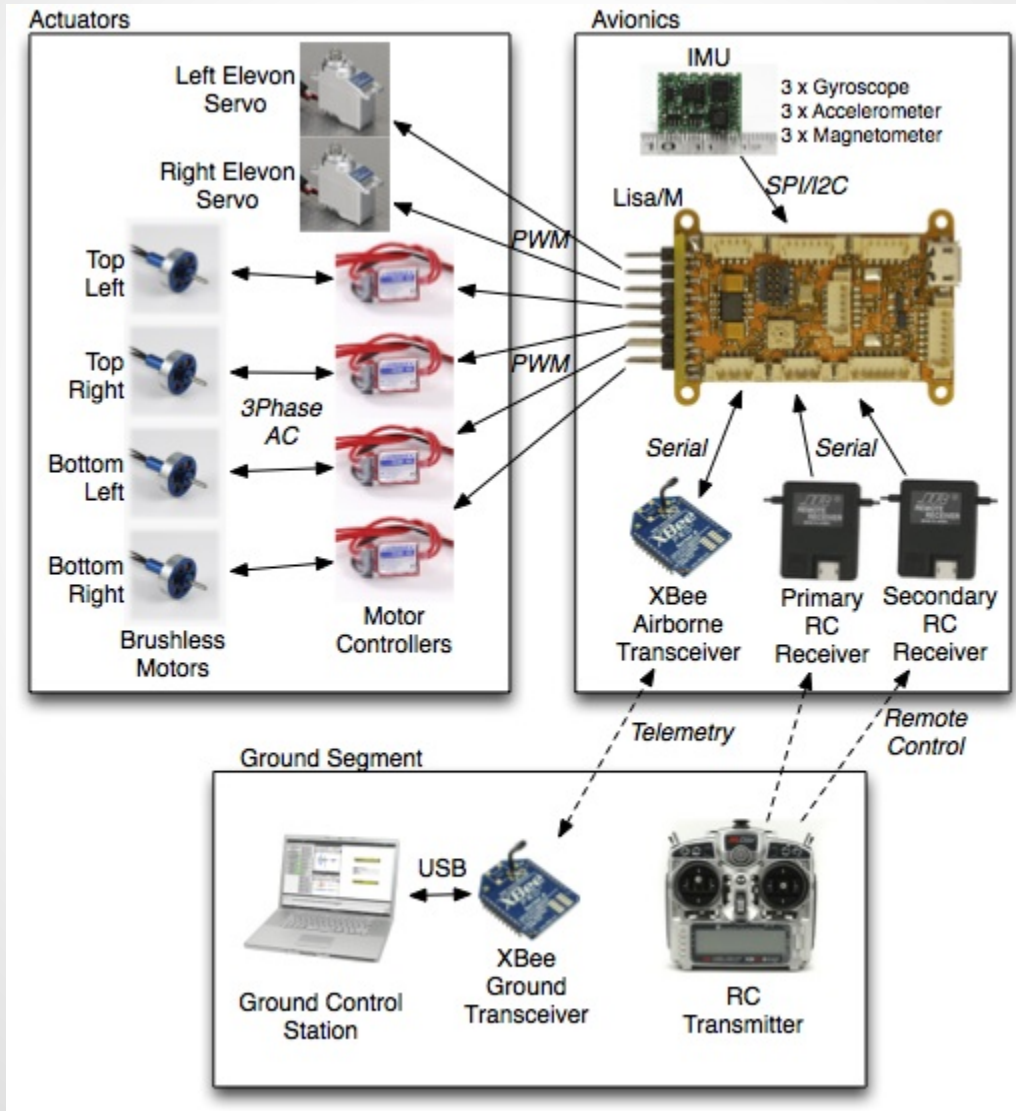
VectorNav IMU



XSens IMU

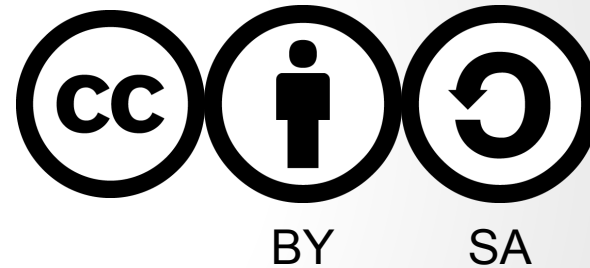


# Hardware - System Example





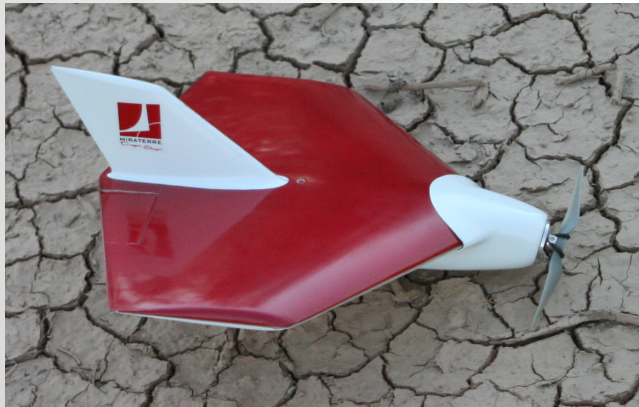
# Hardware - License



# Hardware - Example Vehicles

## Fixed Wing

Dragon Slayer  
Miraterre  
Flight Systems



UMARS  
zhaw  
Zürich Switzerland



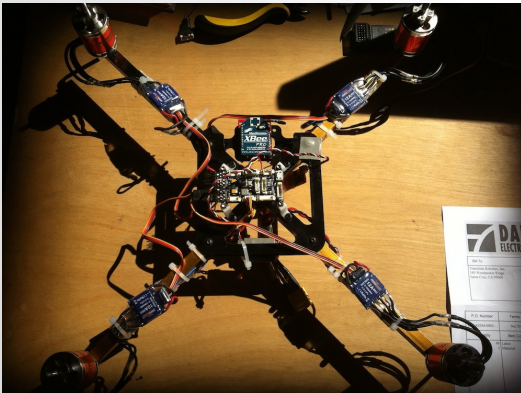
Perching Airplane  
BDML  
Stanford CA US



# Hardware - Example Vehicles

## Multicopter/Rotorcraft

Quady  
Transition Robotics



Variable-Pitch Quad  
Eric Parsonage



Booz Hexa V  
Antoine Drouin



# Hardware - Example Vehicles

## Transitioning Aircraft

Quadshot  
Transition Robotics



Atmov  
Atmos TU-Delft



# Hardware - Demo

- Pray to Lithium-Polymer Gods
- In the front row?
  - Look for a helmet under your seat
  - Just kidding