

Estação de controle para Veículos Aéreos Não Tripulados

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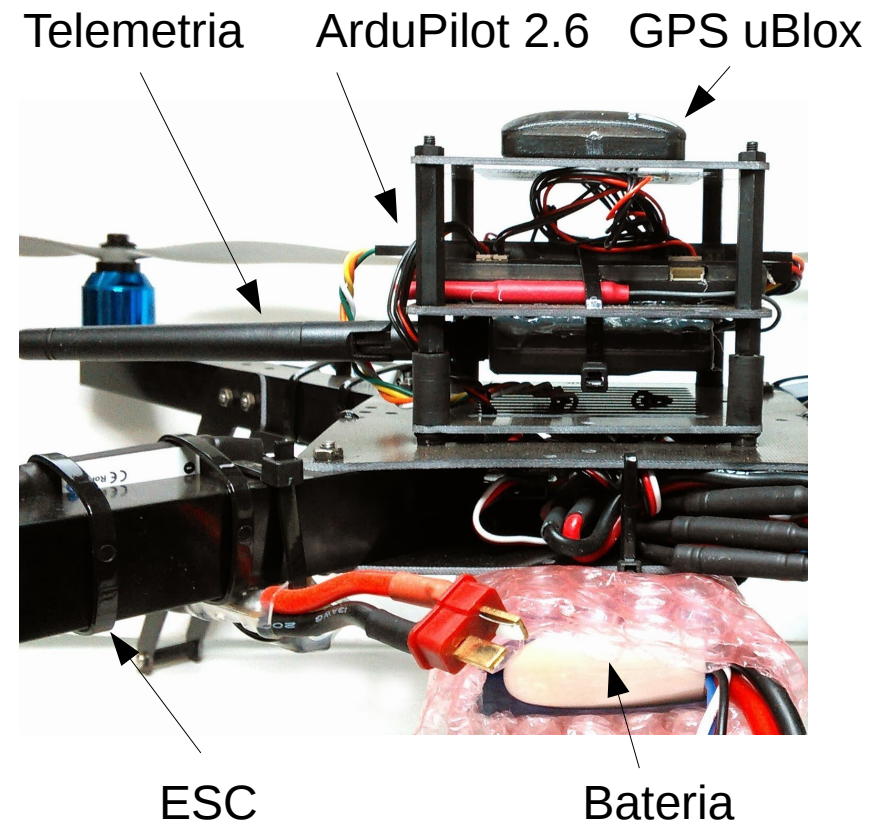
Objetivos

Desenvolvimento de uma Estação de Controle.

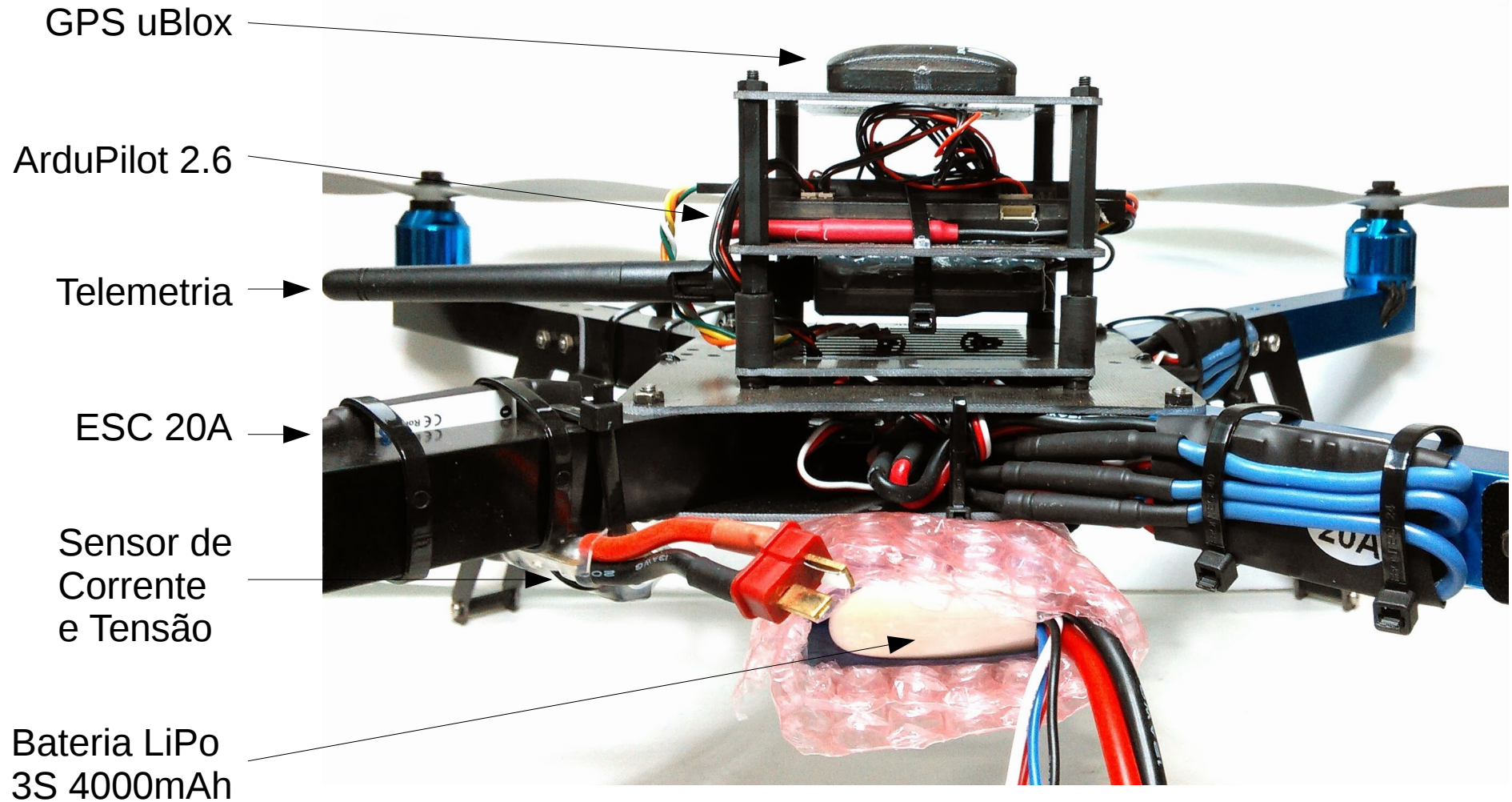
- Visualização de dados de voo em tempo real
- Planejamento de missões autônomas
- Controle do VANT
- Configurar parâmetros do VANT
- Baixo custo
- Portátil
- Fácil utilização em campo

Conceitos: Veículos aéreos não tripulados (VANT)

- Aeronaves que realizam voo autônomo ou assistido por pilotos no solo



Conceitos: Veículos aéreos não tripulados (VANT)



Conceitos: Aerofotogrametria

- Mapeamento topográfico utilizando VANTs
- Planejamento de voo para obtenção de fotos com a sobreposição desejada



Hardware: Estação de controle

Dispositivos Android:

- Programação simples
- Altamente disponíveis
- Baixo custo
- Alto poder computacional
- Baixo peso
- Portáteis



Hardware: Link de comunicação

Necessidades:

- Link de comunicação estável
- 57 kbits/s
- Baixo consumo de energético
- Pequenas dimensões

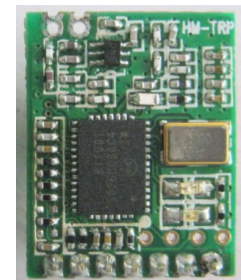
Links Avaliados:

- Xbee
- HopeRF
- WiFi
- Bluetooth

Xbee



Hope-RF



WiFi

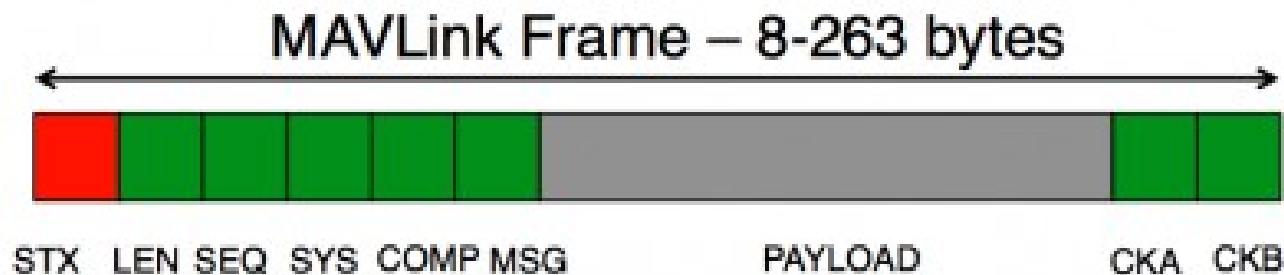


Bluetooth



Link de comunicação: MAVLink

- Protocolo de comunicação open-source para VANTs
- Utilizado por diversos sistemas comerciais
- Baseado no protocolo CAN



Hardware: Link de comunicação USB



Módulos USB disponíveis



Hardware: MAVBridge

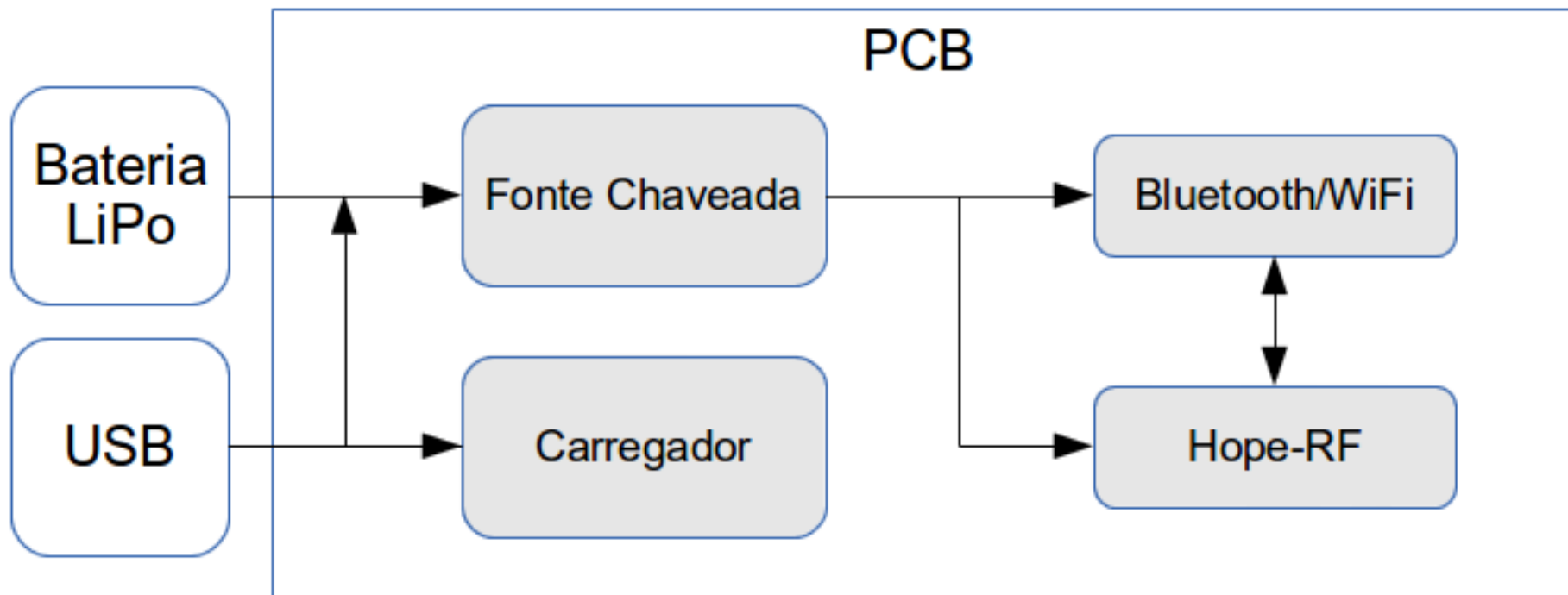
Desenvolvimento de um link de comunicação mais apropriado para esta aplicação.

- Não é necessário ter nenhum dispositivo conectado a estação de controle
- Possibilidade de posicionar a antena em um local mais elevado
- Maior autonomia para a estação de controle



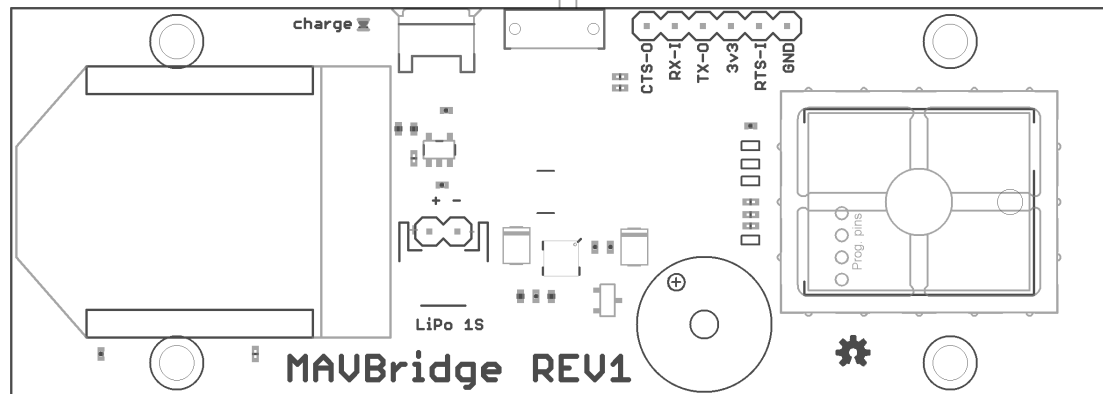
Hardware: MAVBridge

Diagrama de blocos

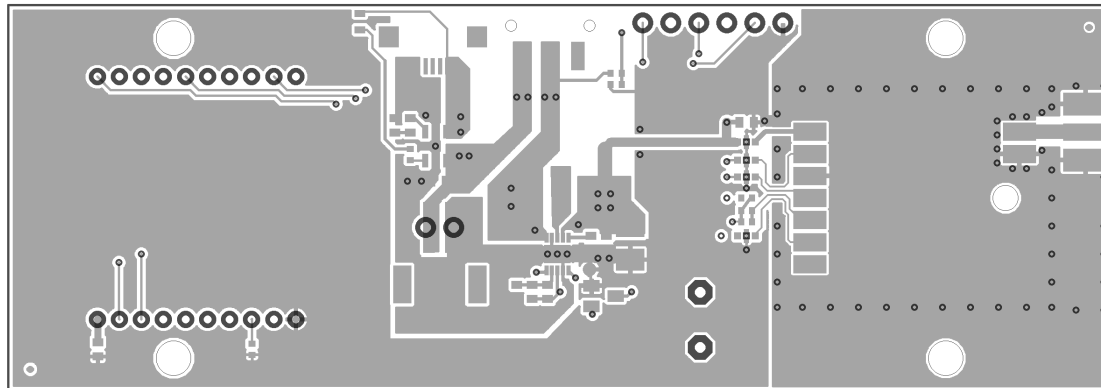


Hardware: MAVBridge

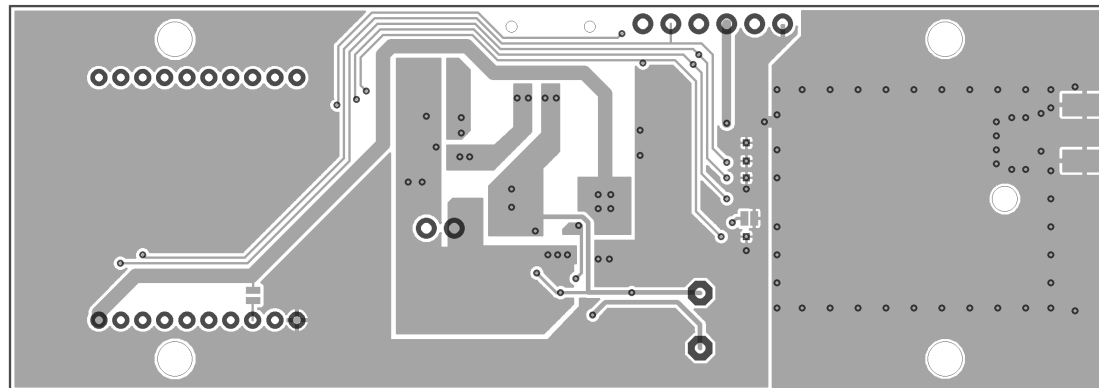
Componentes



Camada superior

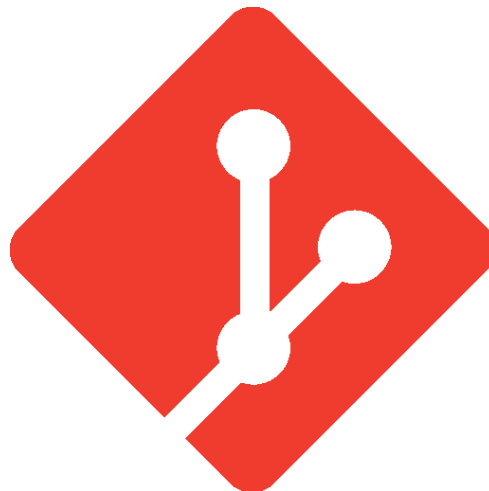


Camada inferior

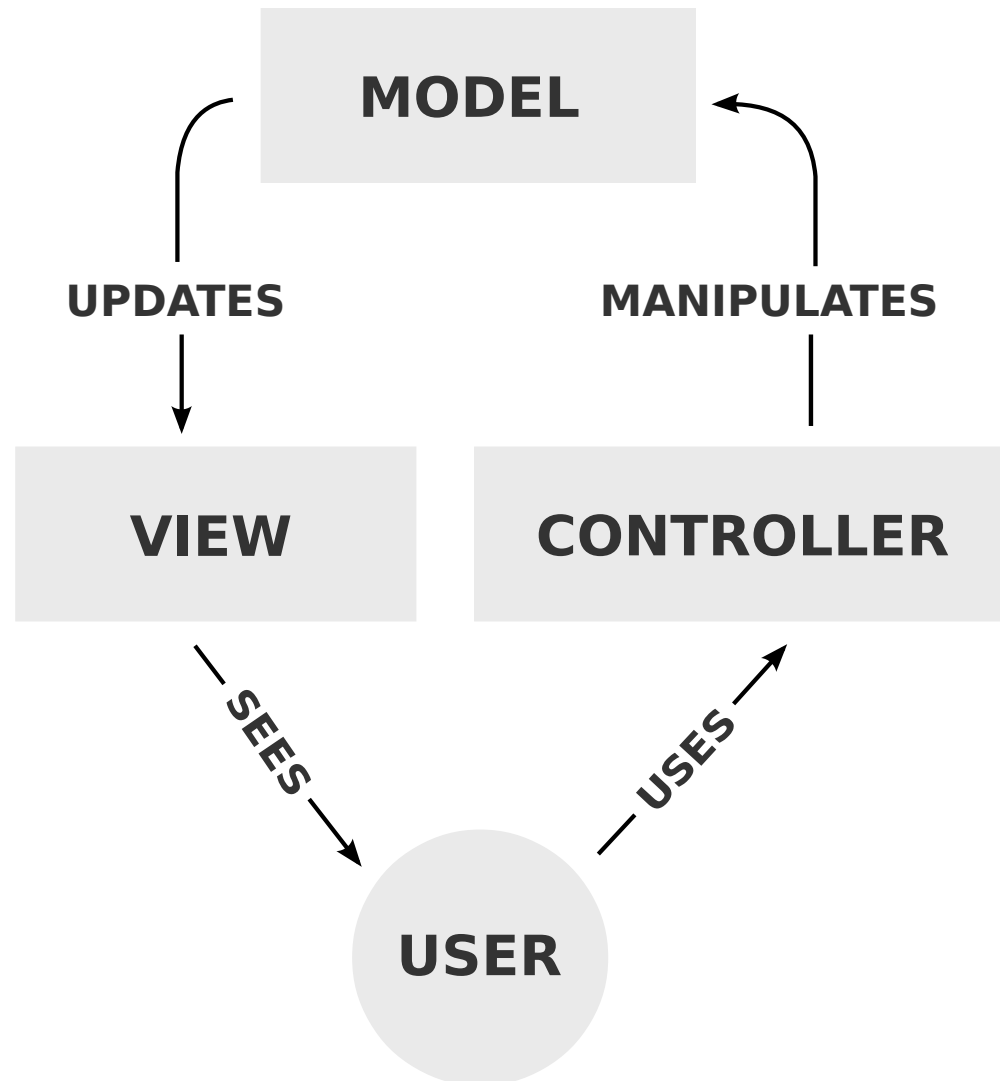


Software: DroidPlanner

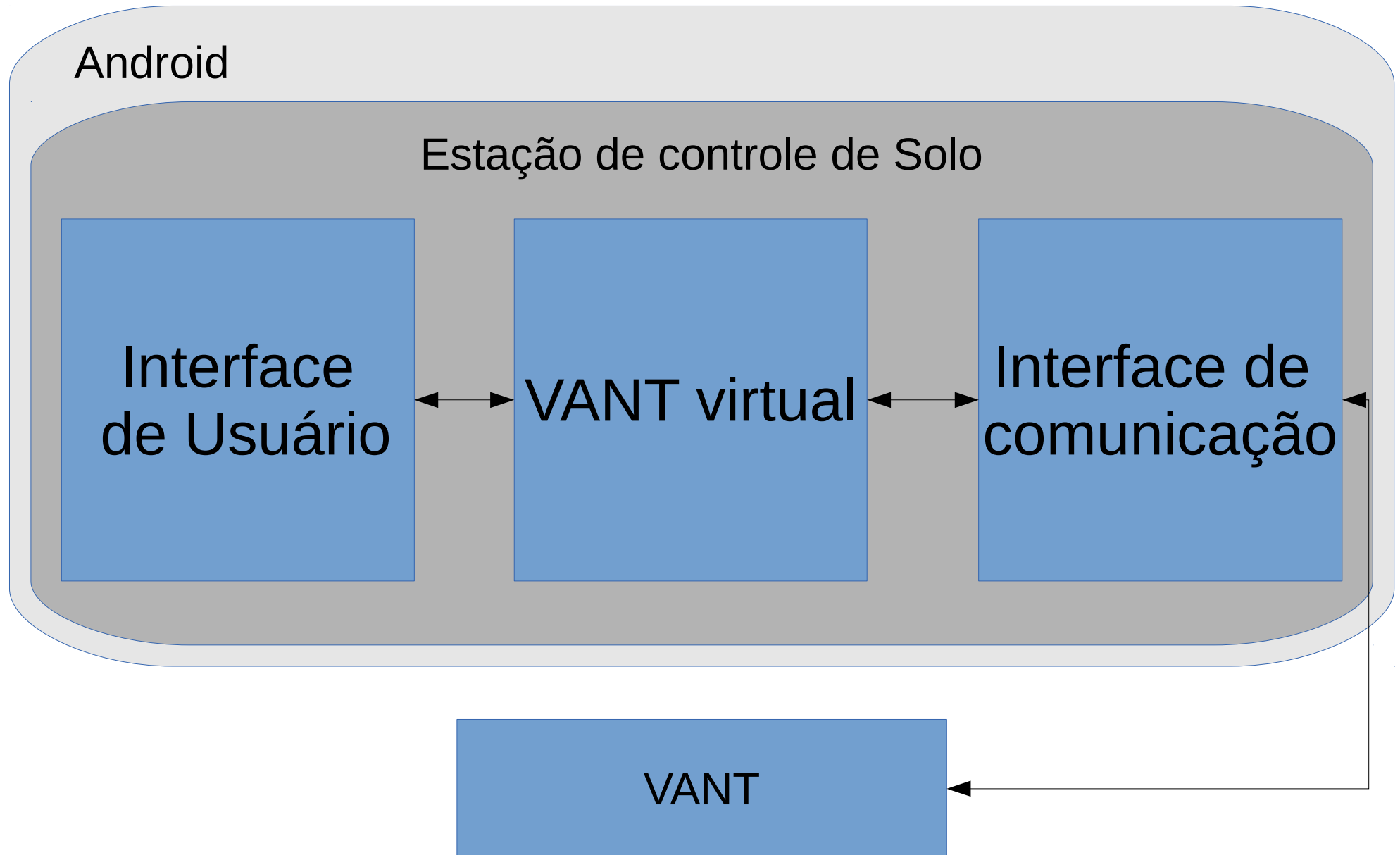
- Android
- Java
- Eclipse
- GNU GPLv3
- GIT
- GITHUB



Software: Modelo MVC

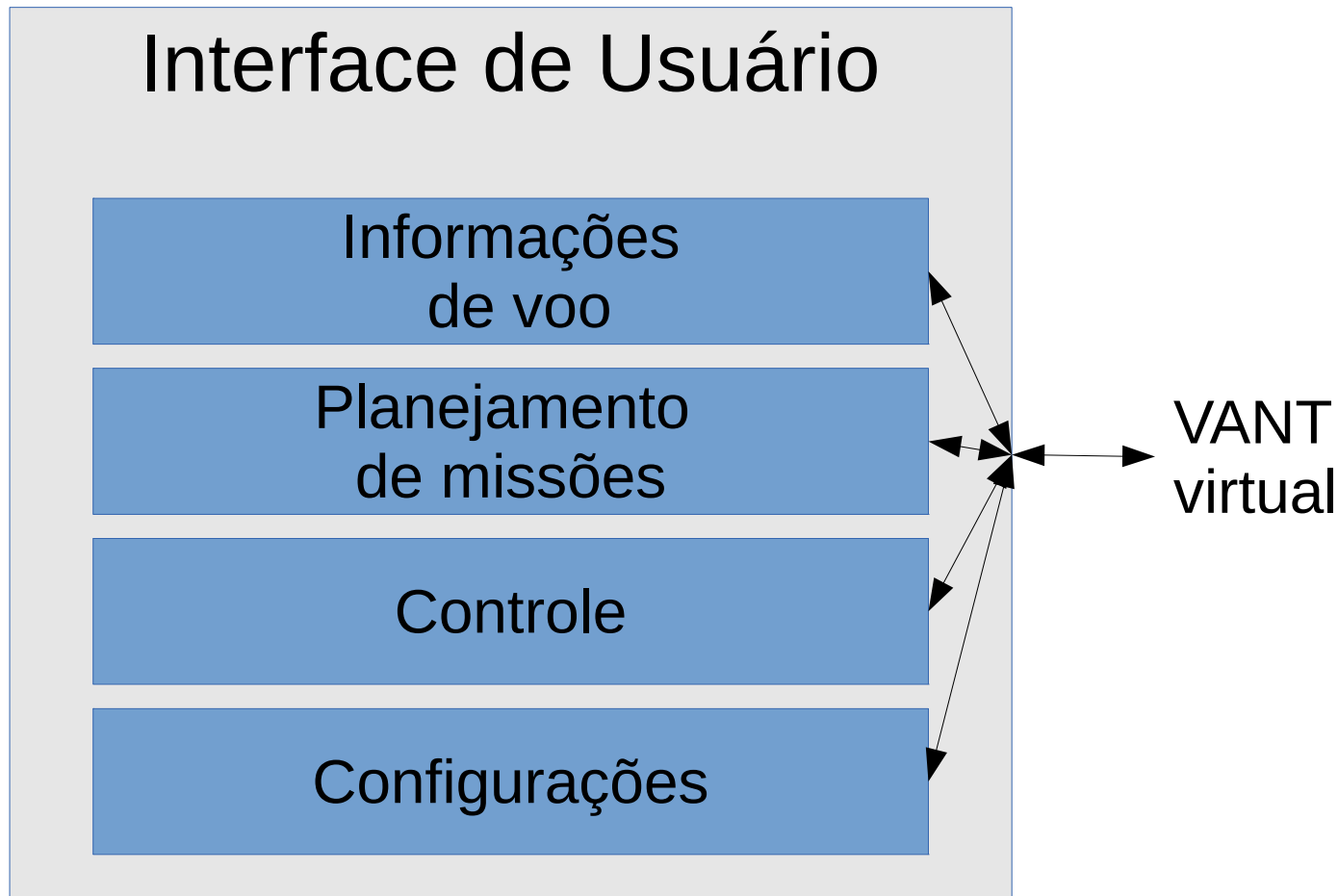


Software: Arquitetura Geral



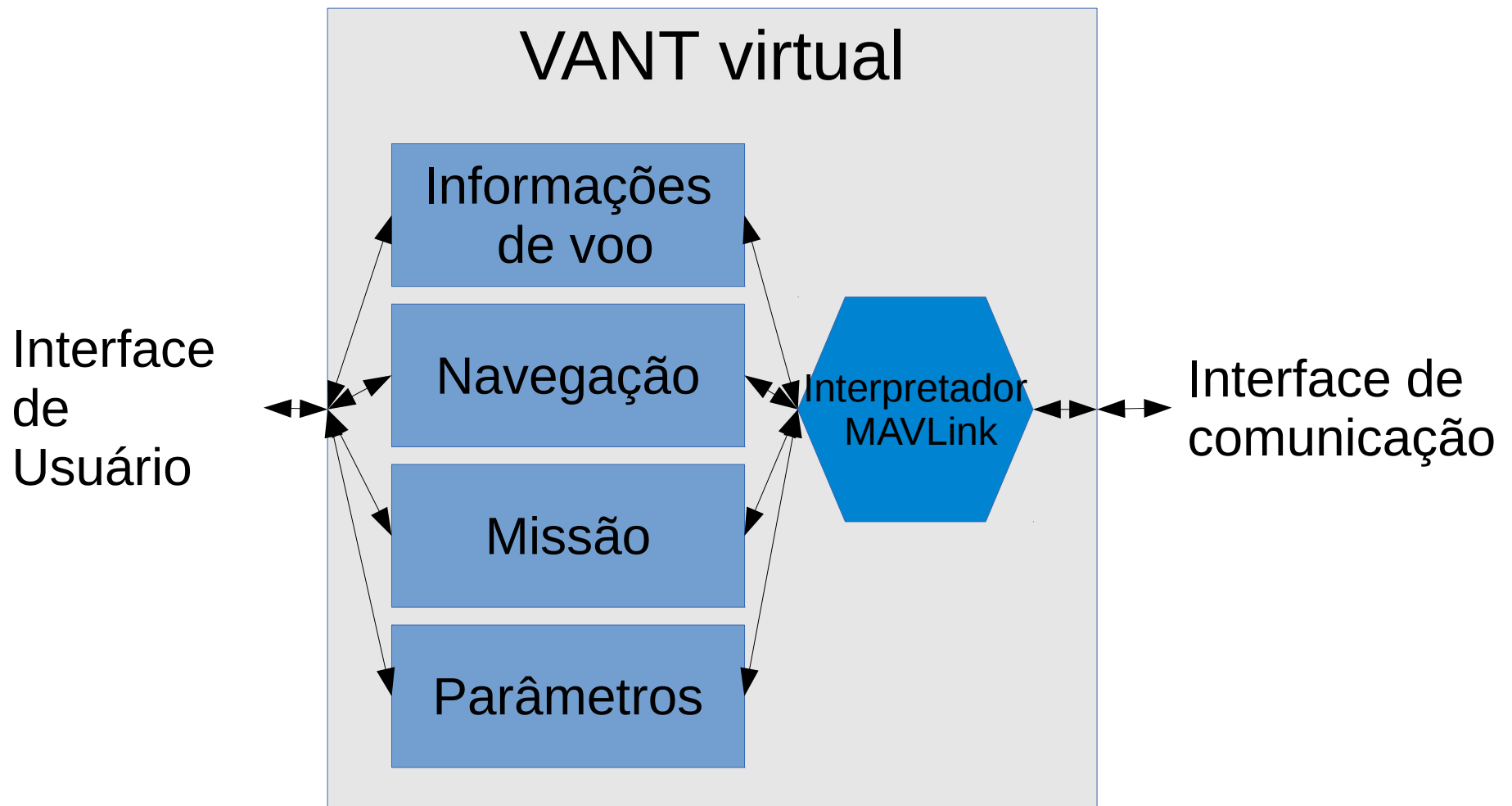
Software: Diagrama da Interface de Usuário

- Meio de comunicação do usuário com a estação de controle
- Exibi dados do VANT virtual



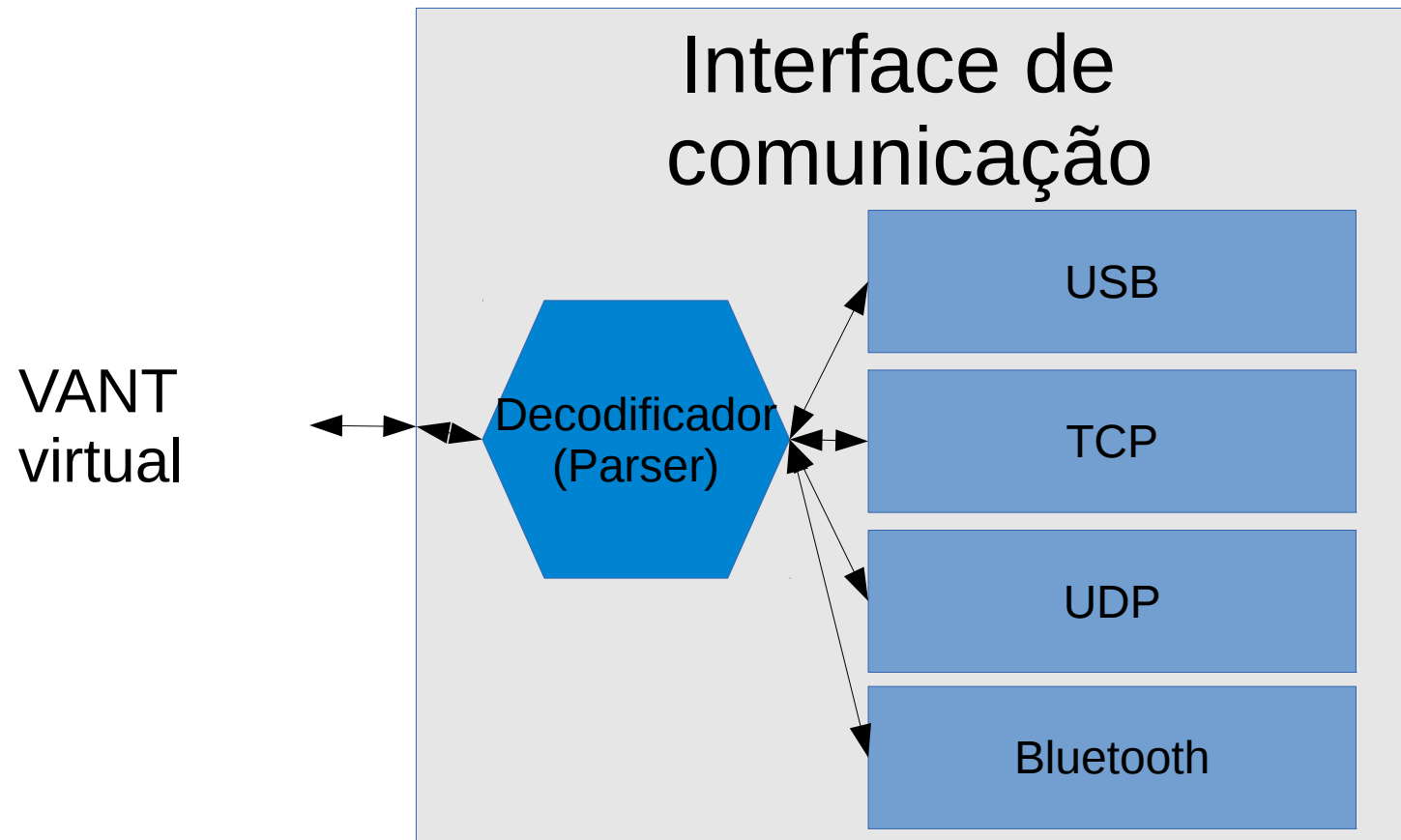
Software: Diagrama do VANT virtual

- Armazena informações localmente do estado do VANT
- Transações de missões
- Decodifica as mensagens do protocolo MAVLink



Software: Diagrama da Interface de Comunicação

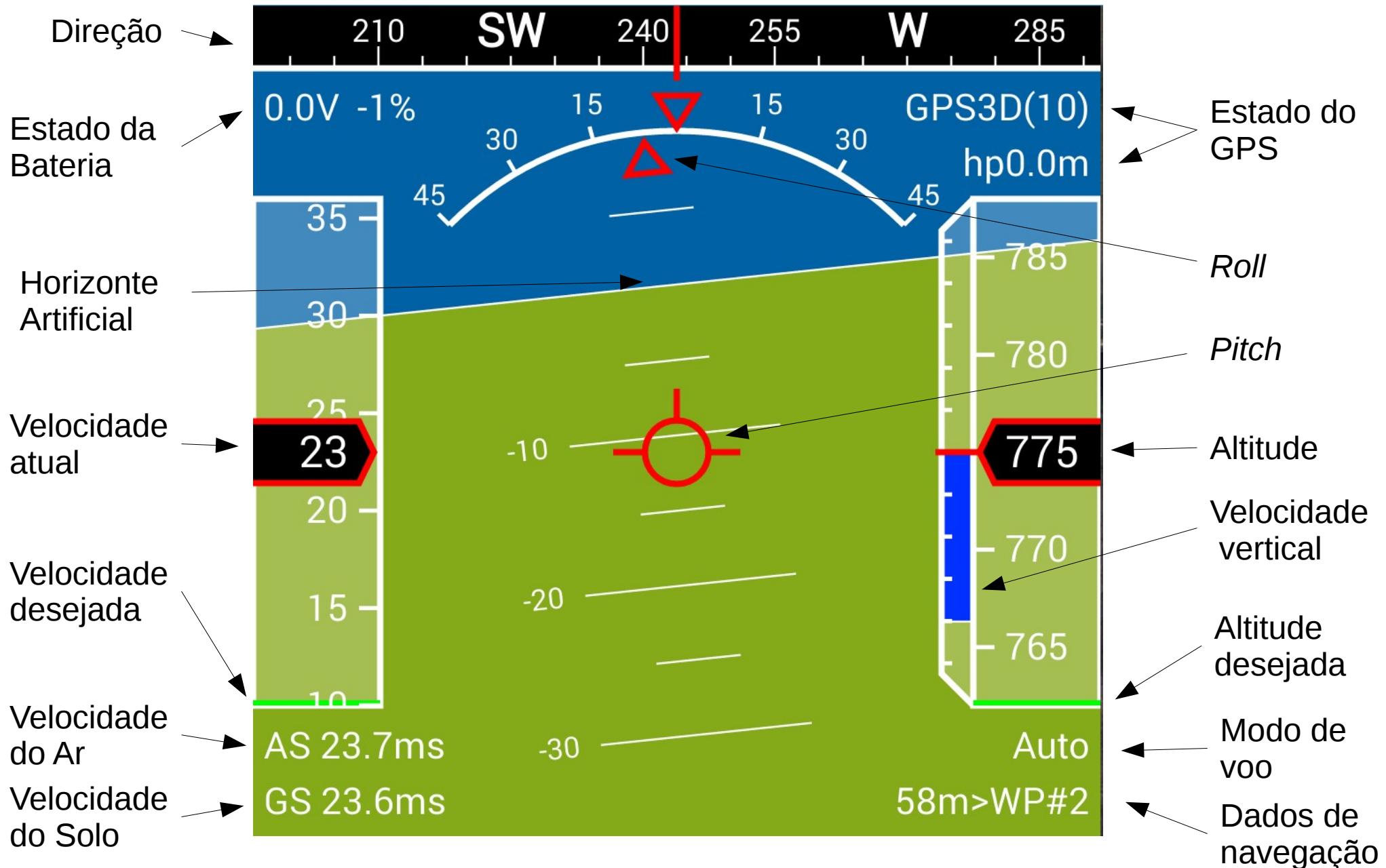
- USB – Comunicação direta com Xbee e modulo HopeRF
- Bluetooth - MAVBridge
- TCP – Link de comunicação 3G
- UDP – Link de comunicação WiFi



Interface de Usuário: Informações de voo



Interface de Usuário: *Heads Up Display*



Interface de Usuário: Planejamento

The screenshot displays a flight planning application interface. At the top, a status bar shows system icons and the time 3:08. Below this is a dark header bar with a green airplane icon and the word "Planning". To the right of the header are buttons: "CHANGE ALT.", "ZOOM", "CLEAR WPS", and "DISCONNECT".

The main area is a satellite map showing a flight path with five waypoints. Waypoint 1 is a pink circle at 200m altitude. Waypoints 2, 3, 4, and 5 are white circles at 100m, 101m, 100m, and 100m altitudes respectively. A yellow line connects the waypoints in the sequence 1-2-3-4-5. A red arrow in the top left of the map area indicates a distance of 2.0 km. A green airplane icon is visible on the map.

At the bottom, a table lists the waypoints with their details:

WP#	ALT	WP Type	Δ WP	Description
1	200m	Takeoff		- Takeoff with pitch set to 30.00°
2	100m	Waypoint	281m	Executing next waypoint immediately, heading is set to 000°
3	101m	Waypoint	769m	Executing next waypoint immediately, heading is set to 000°
4	100m	Waypoint	176m	Executing next waypoint immediately, heading is set to 000°

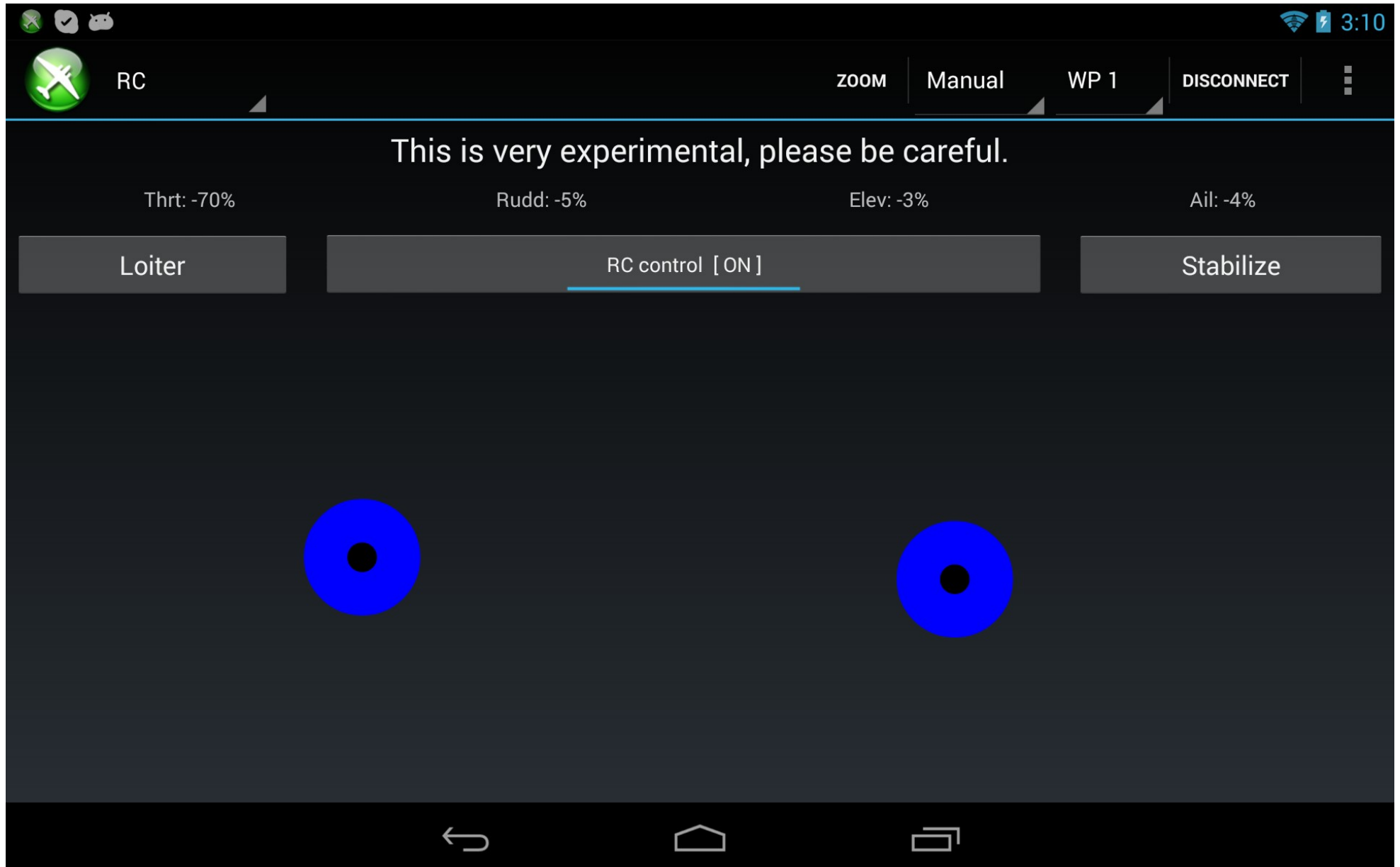
At the bottom right of the table are plus and minus icons. The bottom of the screen shows an Android-style navigation bar with back, home, and recent apps icons. A copyright notice at the very bottom reads: "©2013 Google - Imagery ©2013 Cnes/Spot Image, Landsat, DigitalGlobe, TerraMetrics, Map data ©2013 Google".

Interface de Usuário: Planejamento aerofotogramétrico

The screenshot displays a mobile application for planning aerial photogrammetry missions. The interface is divided into three main sections:

- Top Bar:** Contains a green airplane icon, the word "Planning", and buttons for "CHANGE ALT.", "ZOOM", "CLEAR WPS", and "DISCONNECT".
- Main Map:** Shows a satellite view of a field with a blue flight path and 12 numbered waypoints (1-12). Each waypoint is labeled with its number and "165m". The total distance of the mission is indicated as "Distance: 952.6 m".
- Right Panel:** Displays mission parameters and controls:
 - Camera:** NEX5_16mm.xml
 - Inner WPs:** ☒ (checked)
 - Footprint:** ☒ (checked)
 - Footprint:** 241.3 m x 160.9 m
 - Ground Resolution:** 2.73 cm²/px
 - Distance Between Pictures:** 80.4 m
 - Distance Between Lines:** 190.6 m
 - Area:** 0.2 km²
 - Mission Length:** 952.6 m
 - Pictures:** 12
 - Number Of Strips:** 6
 - Hatch angle:** 80.0 °
 - Flight Altitude:** 165.0 m
 - Overlap:** 50.0 %
 - Sidelap:** 21.0 %
 - Buttons:** "Polygon" and "Clear Poly"

Interface de Usuário:



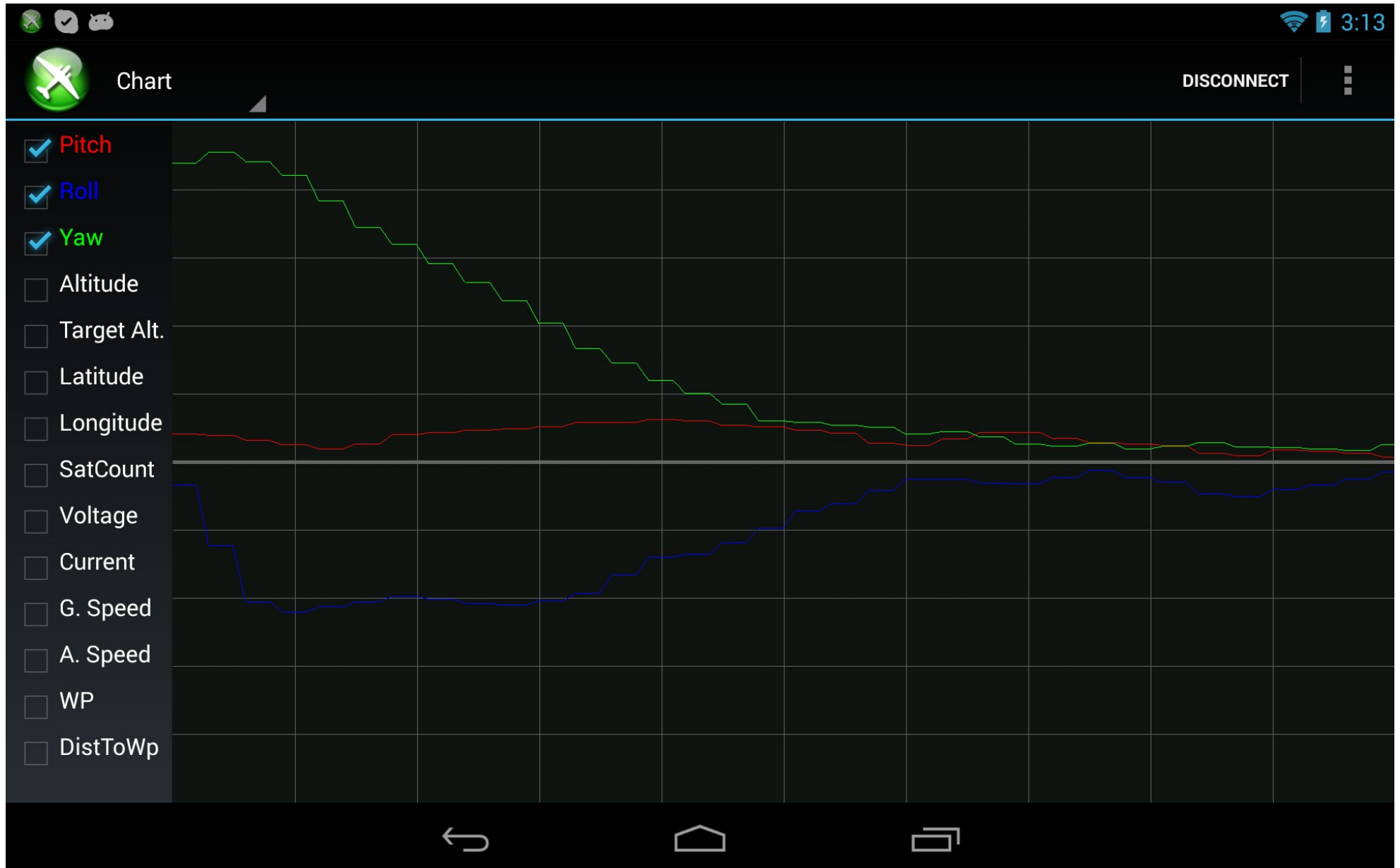
Interface de Usuário:



The screenshot shows a mobile application interface with a dark theme. At the top, there is a status bar with icons for signal, battery, and time (3:11). Below the status bar is a header bar with a green circular icon containing a white airplane, the text "Parameters", and three buttons: "REFRESH", "WRITE", and "DISCONNECT". A vertical menu icon is also present on the right side of the header. The main content area is a list of parameters, each with a label, a description, and a numerical value in a text input field. The parameters are: ACRO_PITCH_RATE (180), ACRO_ROLL_RATE (180), AHRS_COMP_BETA (0.1), AHRS_GPS_GAIN (1), AHRS_GPS_MINSATS (6), AHRS_GPS_USE (1), AHRS_ORIENTATION (0), AHRS_RP_P (0.3), AHRS_TRIM_X (0), AHRS_TRIM_Y (0), AHRS_TRIM_Z (0), and AHRS_WIND_MAX (0). At the bottom, there is a navigation bar with three icons: a back arrow, a home icon, and a recent apps icon.

Parameter	Description	Value
ACRO_PITCH_RATE	ACRO mode pitch rate (degrees/second)	180
ACRO_ROLL_RATE	ACRO mode roll rate (degrees/second)	180
AHRS_COMP_BETA	AHRS Velocity Complimentary Filter Beta Coefficient	0.1
AHRS_GPS_GAIN	AHRS GPS gain	1
AHRS_GPS_MINSATS	AHRS GPS Minimum satellites	6
AHRS_GPS_USE	AHRS use GPS for navigation	1
AHRS_ORIENTATION	Board Orientation	0
AHRS_RP_P	AHRS RP_P	0.3
AHRS_TRIM_X	AHRS Trim Roll (Radians)	0
AHRS_TRIM_Y	AHRS Trim Pitch (Radians)	0
AHRS_TRIM_Z	AHRS Trim Yaw (Radians)	0
AHRS_WIND_MAX	Maximum wind (m/s)	0

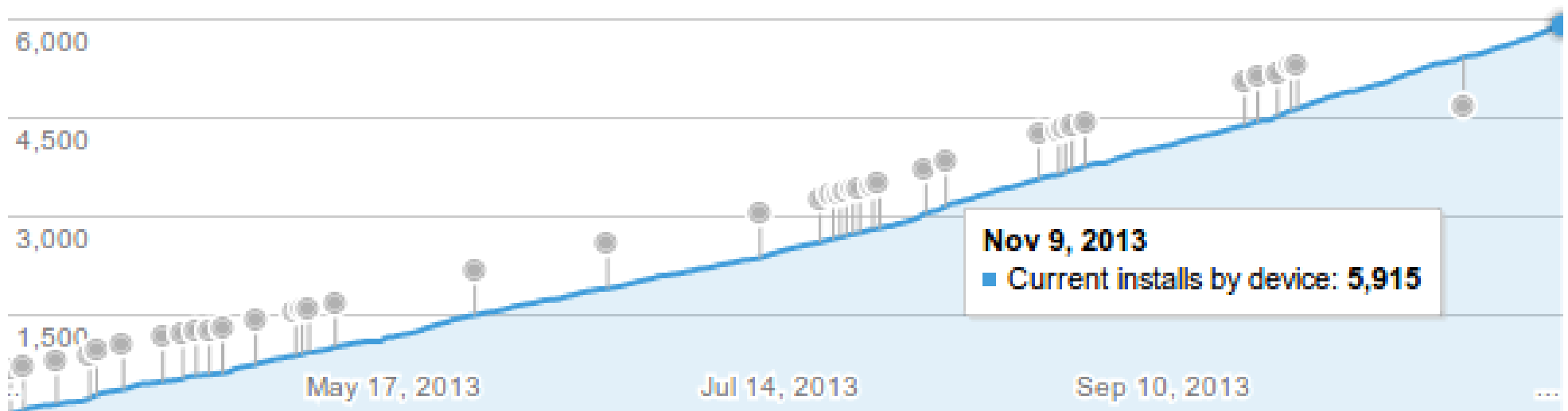
Interface de Usuário:



Resultados: Open-Source

Dados quantitativos sobre o projeto:

- 24 desenvolvedores
- 1595 sub-versões (*commits*)
- ~ 50000 linhas de código fonte
- ~ 970 arquivos
- Traduzido para 12 línguas diferentes
- 12 meses de desenvolvimento



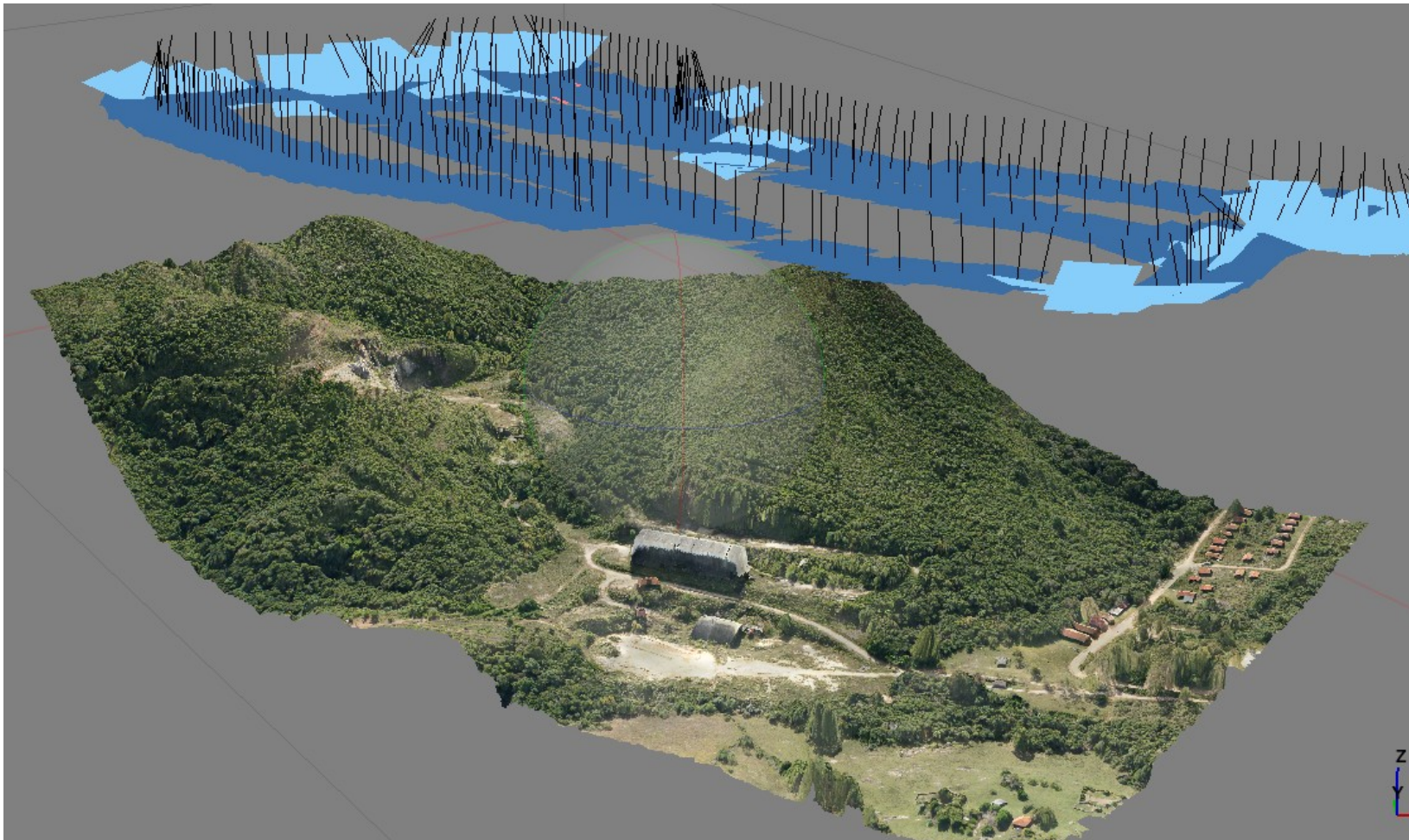
Resultados: Dispositivos Android testados

- **Nexus 7 (2013)**
- Nexus 5
- Nexus 4
- Nexus 10
- Asus TF300T and TF300TG
- Samsung Galaxy Note 2
- Samsung Galaxy Note 3
- Samsung Galaxy Tab 2 7.0
- Samsung Galaxy Tab 10.1
- Samsung Galaxy S3
- Samsung Galaxy S4
- Samsung Galaxy Nexus
- Xperia Z and Z1
- Tablet Genesis GT-7230
- T-pad tablet IS701 and IS709C
- Acer Iconia A500, A501 and A510



Resultados: Aerofotogrametria

- Exemplo de resultados obtidos com um voo auxiliado por estação de controle de solo



Obrigado!

