Robotic buoys…. and everything that goes around them!

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Swiss Sailing Day 2023 | 04. März 2023

Robotic buoys…. and everything that goes around them!

- Intro & FAQ
- Design
- Early adopters
- Why robotic buoys are “expensive“?
- How to finance robotic buoys?
- Rules on the Swiss lakes
- Robotic buoys and Racing Rules of Sailing
- Let‘s build a robotic buoy workshop

Intro & FAQs

Intro & FAQs

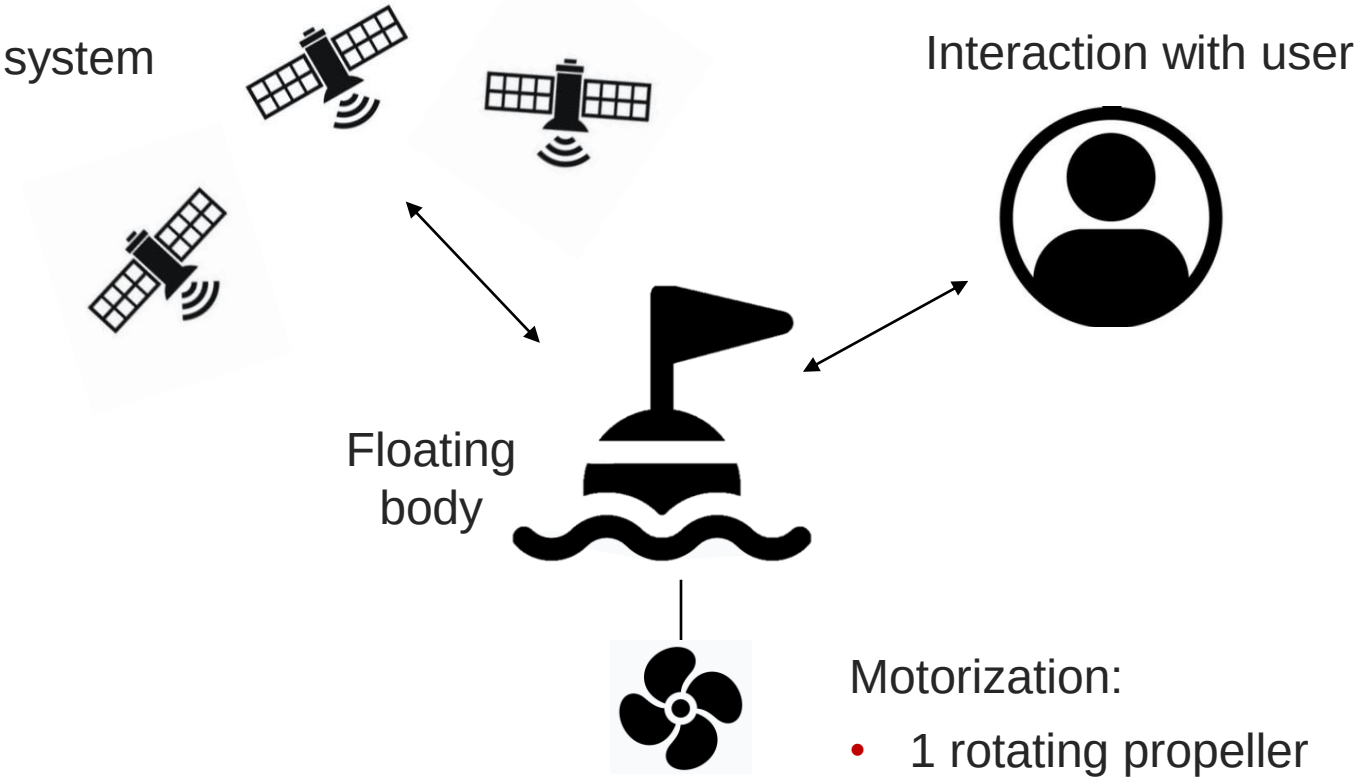
Robotic marks are anchorless self-propelled buoys.

Why do we need them?

- Precision
- Lack of personnel
- Quick courses adjustment
- Environment (anchoring forbidden / leaving weights and ropes on the seabed / fuel savings)

Intro & FAQs

Dynamic positioning



Motorization:

- 1 rotating propeller
- 2 or more propellers

Nice to have options: wind sensor – camera – light – horn ….

Intro & FAQs

Positioning VS communication

Positioning

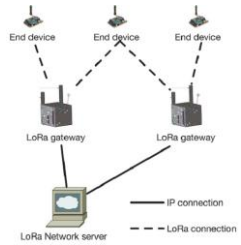
Satellite

- GLONASS
- GPS
- BEIDOU
- GALILEO

Communication

Long range:

- GSM



Medium range:

- WiFi network
- LoRa
- Radio

Short range:

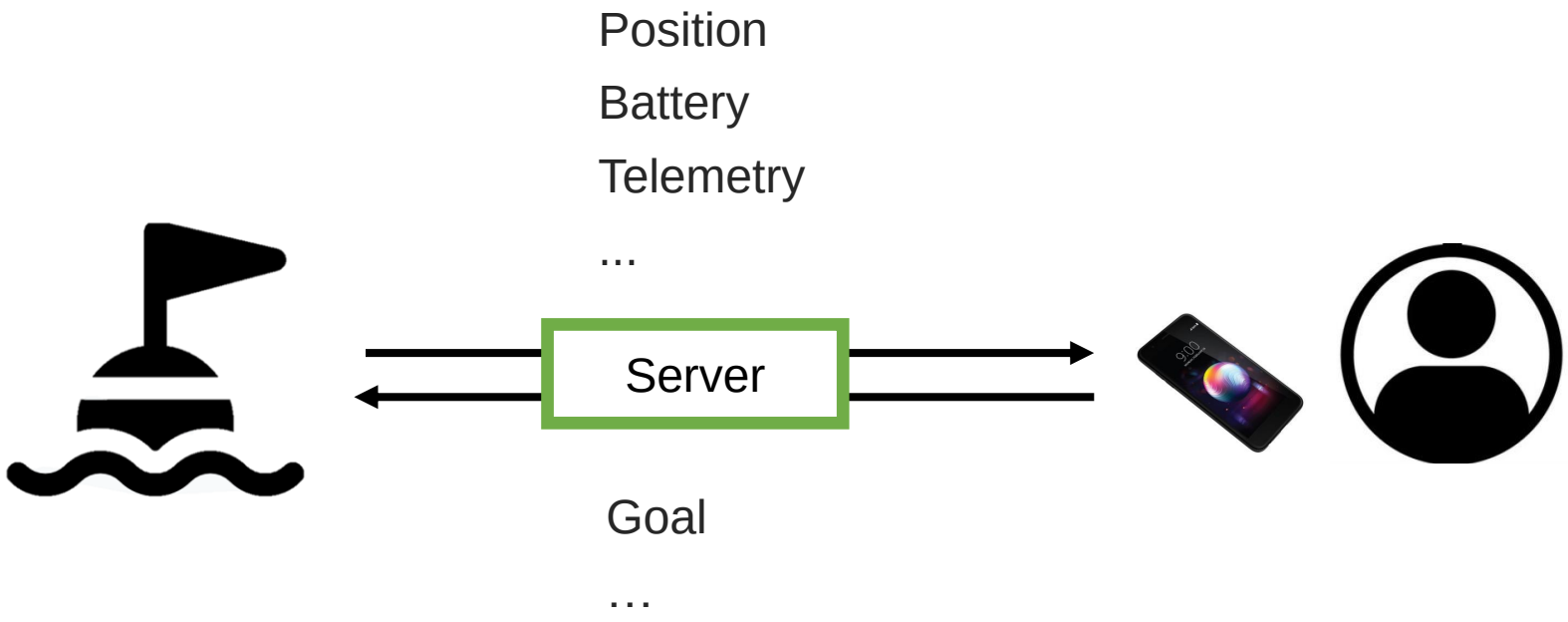
- Bluetooth

No range:

Push buttons

Intro & FAQs

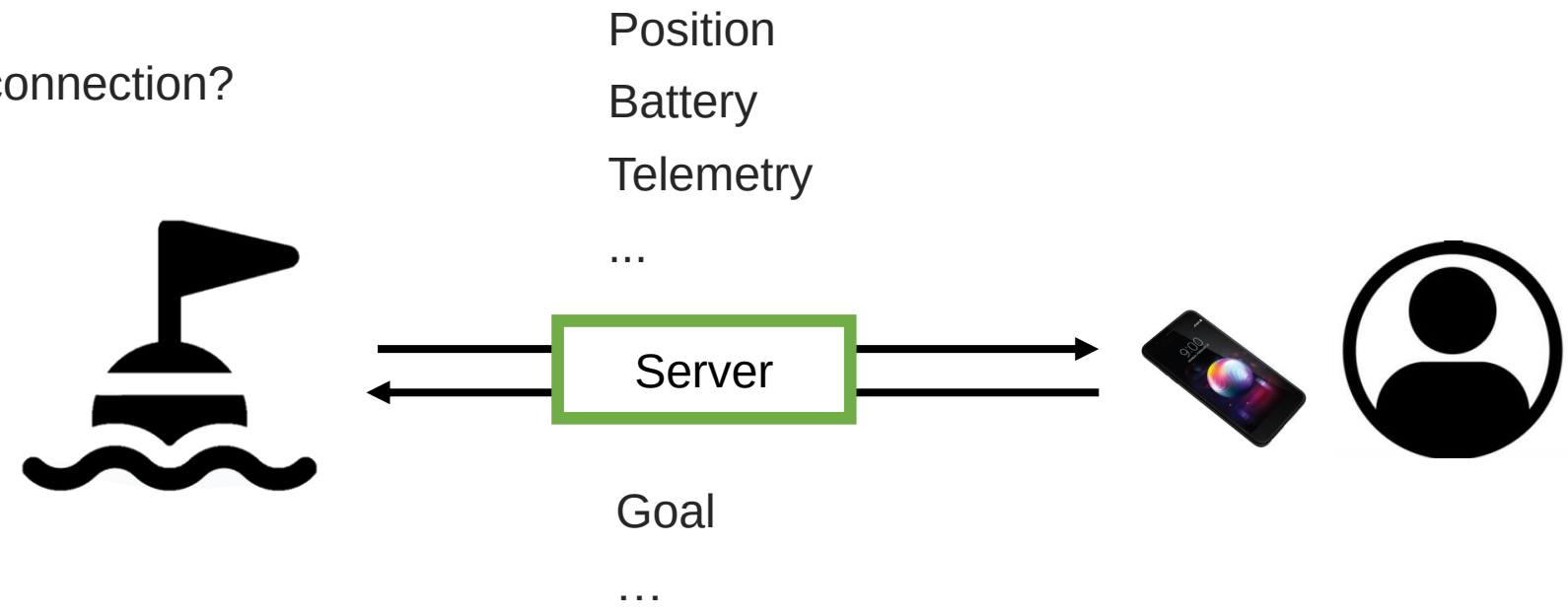
Communication with user



Intro & FAQs

What happens if the buoy loses connection?

The buoy will hold it‘s position.



Die Module sind auf Präzisionsautomaten gefertigt, mit eloxierten Universalrahmen sowie hagelfestem Sicherheitsglas ausgestattet.

36 monokristalline Solarzellen sind in Reihe geschaltet, ideal für 12V Batterieladung.
Auf der Rückseite befindet sich die wasserdichte Anschlussdose, in der das Anschlusskabel direkt angeschlossen werden kann.

Diese Qualitätsmodule lassen wir unter unserer strengsten Qualitätskontrolle fertigen. Hierbei wird vor allem auf Leistung sowie beste Verarbeitung Wert gelegt und von uns ständig kontrolliert.
Dies ist keine Billigware sondern hochwertigste und kontrollierte Qualitätsware.

Art:	Monokristallines Silikon
Grösse:	345*240*18mm
Anzahl Zellen:	36
Power:	10W
Solarzellen-Marke:	A Grad SunPower Zellen
Verbindungsbox:	Rückseitig ohne Kabel
Installation:	kann geklebt oder geschraubt werden
Besonderheiten:	bestes Preis-Leistungs-Verhältnis, effizient und

Technische Daten:

Maximum Power (+/- 5%) - Pmax	10 W
Leerlaufspannung - Voc	21.3V
Kurzschlussstrom - Isc	0.61 A
Maximum Power Voltage (Vpm)	17.8 V
Maximum Power Current (Imp)	0.56 A

Buoy @ 15 kt ~ 100 W

Intro & FAQs

Solar panels, are they worth it?

- Gain?
- Cost?
- Risk of breaking it?

Design

Design

Many (all?) robotic marks producers come from different environments and hence their buoys are different.

Every single design choice has a reason to be there, judgement is useless, questions are welcome!

Design

Main choice example	Sponsor visibility	Low weight	Low price
Main characteristic	→ Bigger surface	→ Aerodynamic	→ Minimal
Consequence 1			
Consequence 2			
Consequence x	……	……	……

Design

Main choice example	**Sponsor visibility**	**Low weight**	**Low price**
Main characteristic	→ Bigger surface	→ Aerodynamic	→ Minimal
Consequence 1	→ Big drag – Big weight	→ No big sponsor space	→ Less functions
Consequence 2	→ Easier to sell to sponsored clubs	→ Exploitable for trainings	→ Easier to sell as training mark
Consequence x	……	……	……

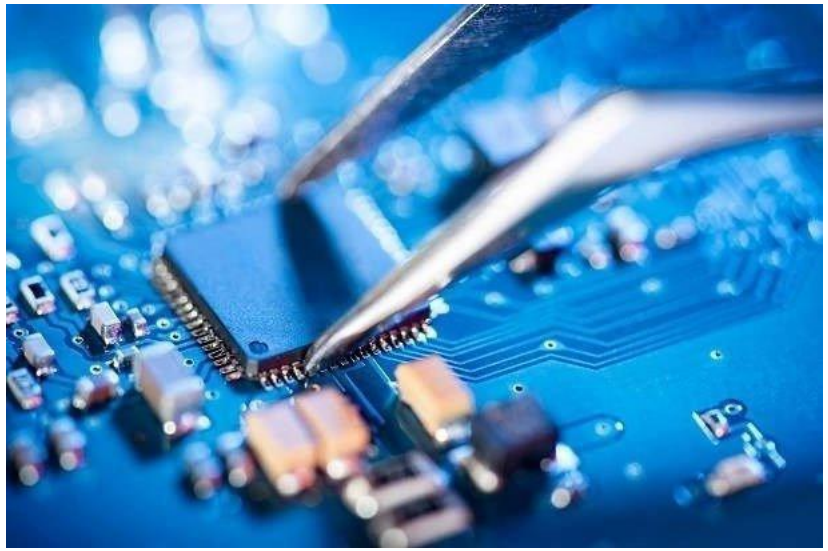
Early adopters

Early adopters

- Very important clubs/associations.
- They support a developer with tests
- They are brave
- With their inputs, they contribute to shape the buoy
- They often get discounts in exchange

Why robotic marks are „expensive“ ?

Why robotic marks are „expensive“ ?



You are buying many products all together:

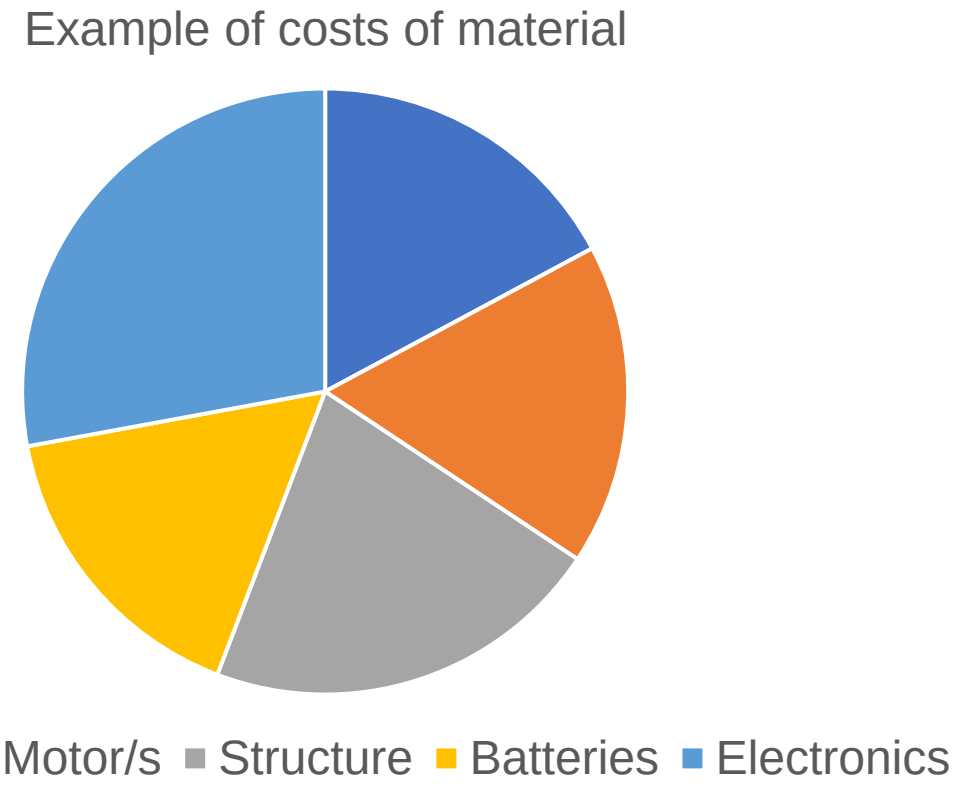
- Structure: fiberglass - woven drop stitch - aluminum …
- Custom-made inflatable (often)
- Brushless motor/s with an expensive battery (often with a Battery Management System)
- Positioning hardware (autopilot, GPS…)
- Communication hardware (computer, GSM/LoRa/… module)
- Software: server + user app

Why robotic marks are „expensive“

The components have prices of the same order of magnitude, if we even managed to reduce the cost of the structure we are still left with high costs (battery – motors – electronics)

In sailing there is no sufficient demand for big orders (the discount on parts is low)

Many components are becoming more expensive



How to finance robotic buoys?

How to finance robotic buoys?

- Environment
- Sponsoring
- Safety

Rules on the lakes

Rules on the lakes

Vessels below 2.5 m cannot be motorized.

What are the rules applying for robotic buoys? Can we consider them as RC boats?

“To your question, we reply that the buoy is in no way compared to a radio-controlled model but rather to a motorized vessel and therefore its use in navigation on regulated waters is forbidden. Its use is exceptionally tolerated to keep the stationary mark at the necessary point, only within the authorized regatta area. ”

(January 2023, Swiss Police)

Robotic buoys and Racing Rules of Sailing

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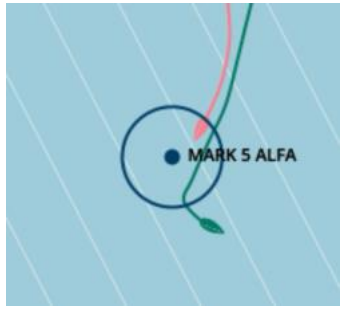
Robotic buoys and Racing Rules of Sailing



Tracker precision: +/- 5 meters

Robotic buoys and Racing Rules of Sailing

The current rules don’t make any distinction between anchored and robotic buoys.

RRS 43.1 is changed to add RRS 43.1(d):
“(d) A boat shall be exonerated from breaking RRS 31 if the umpires are satisfied that the breach is entirely due to a robotic mark adjusting its position.”

Robotic buoys on the market in alphabetic order:

- GiPSy – SUI
- MarkSetBot – USA
- Robomark - SUI
- SMark - SUI
- Smartmark - GER
- VR Buoy - ITA

Thank you!