

# Robotic buoys.... and everything that goes around them!

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## **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

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Robotic marks are anchorless self-propelled buoys.

Why do we need them?

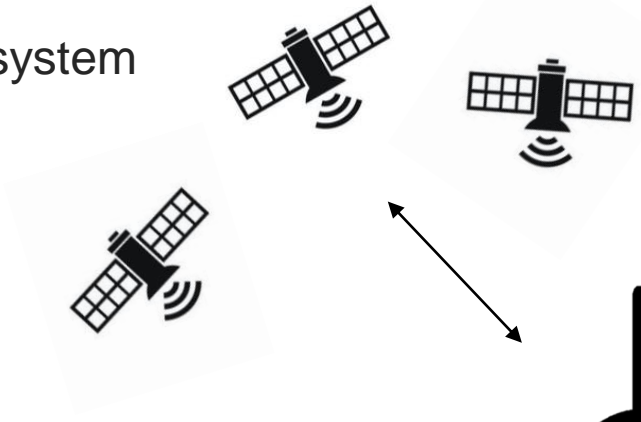
- Precision
- Lack of personnel
- Quick courses adjustment
- Environment (anchoring forbidden / leaving weights and ropes on the seabed / fuel savings)



## Intro & FAQs

### Dynamic positioning

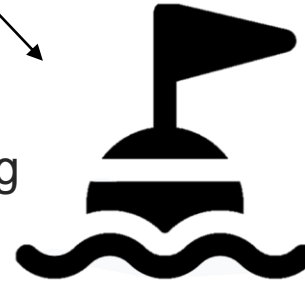
Positioning system



Interaction with user



Floating  
body



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

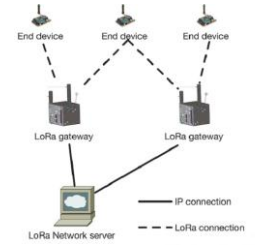
#### Long range:

- GSM



#### Medium range:

- WiFi network
- LoRa
- Radio



#### Short range:

- Bluetooth



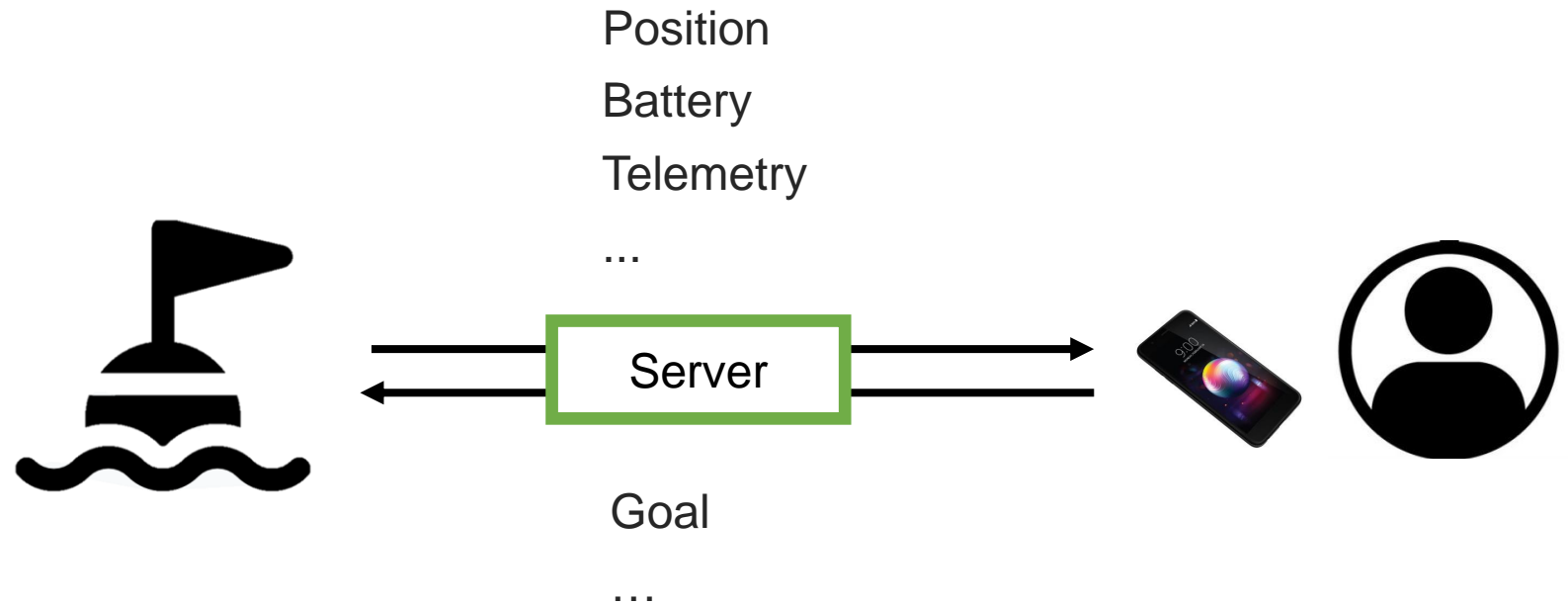
#### No range:

Push buttons



## Intro & FAQs

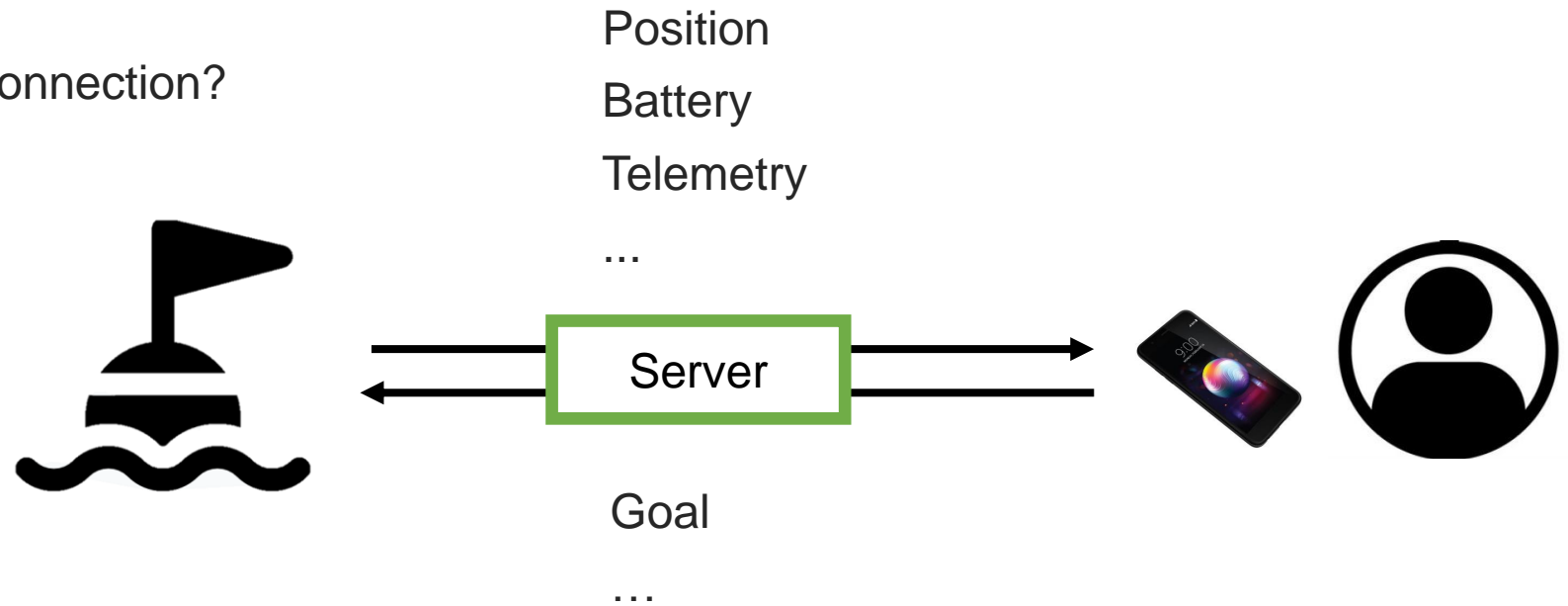
Communication with user



## 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 Batterieaufladung.

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

**Buoy @ 15 kt ~ 100 W**

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



## 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

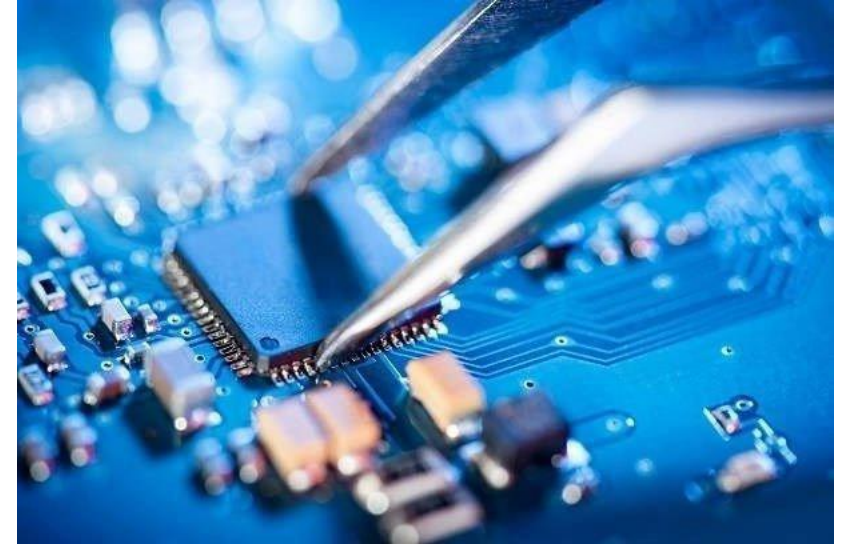
## **Why robotic marks are „expensive“ ?**



## 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



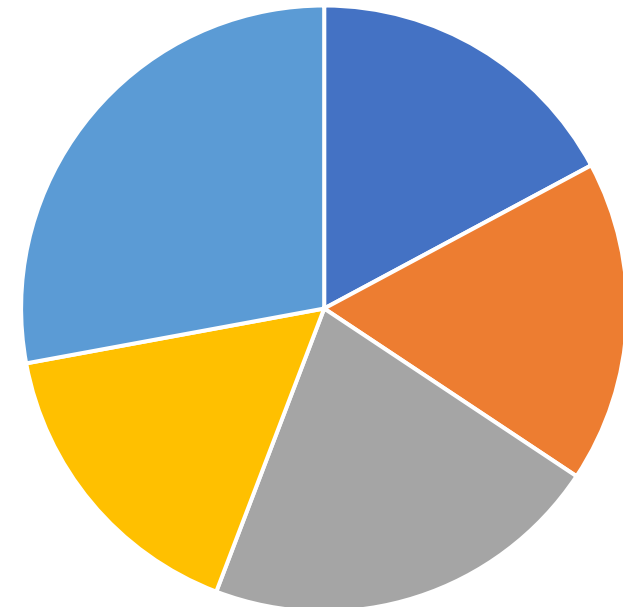
## Why robotic marks are „expensive“

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

Example of costs of material



■ Inflatable ■ Motor/s ■ Structure ■ Batteries ■ Electronics

# 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

## 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!**