Developing a Portable Wind Monitoring System for Sailing Events

Overview

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Overview of topic

Sailing is a sport that requires competition organizers to have accurate wind measurements to prepare a fair racing environment.
The measured wind speed dictates the length and the direction sets the course axis.

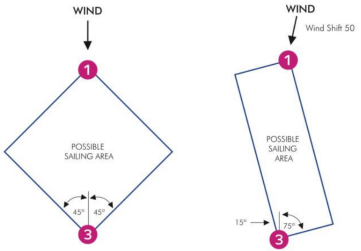

Figure: Effect of an improperly aligned course axis

Existing Solutions

- Manual measurement
- Commercially available portable solutions
- Yachting hardware

Figure: YachtBot WindBot

Goals

- Automate measurements

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- Automate data transfer

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- Automate measurements
- Automate data transfer
- Reduce price compared to commercial solutions

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Strategy

- Make use of existing hardware
  - Carbon pole
  - Wind sensor
  - Display

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- Correct direction readings using a magnetic compass

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- Correct direction readings using a magnetic compass
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- Send data over cellular network

Difficulties

- Hardware selection

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- Hardware issues

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- Cellular network connection problems
- Library support

Difficulties: Hardware Selection

My lack of knowledge on the types of magnetic compasses required lengthy research and culminated in my disassembly of the compass I typically use when sailing to determine the used sensor.

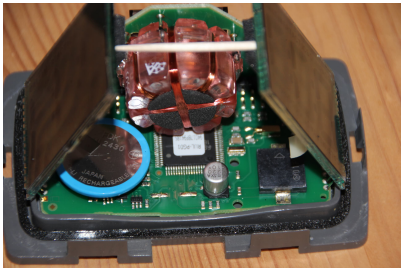

Figure: Raymarine Tacktick Micro Compass extracted from its housing and exposing the used fluxgate magnetometer

Difficulties: Hardware Interoperability

Two of the chosen HATs had a non-obvious pin collision resulting in an unusable CAN interface.

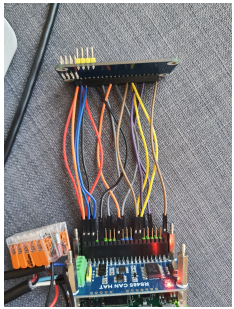

Figure: Connection between the offending HATs replaced with individual jumper cables

Difficulties: Hardware Issues

- Loose contact in USB connection to the GPS HAT
- Loose connection to onboard power
- Undampened gimbal suspension of the fluxgate compass core
- Water ingress into connectors

Difficulties: Cellular network connection problems

- No network coverage in the race area during the test in Kiel
- Inability to establish cellular internet connection with the internal modem

Difficulties: Library support

- No python library for NMEA2000
- No python library for the used IMU with support for the on-chip queue

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  - 3D print and design files for the enclosure and mounting hardware
  - Bill of Materials
  - Setup instructions for the Raspberry Pi

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- Instructions to recreate the project
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  - Bill of Materials
  - Setup instructions for the Raspberry Pi
- Improved mounting option on the used boat as well as a new locking power socket

Evaluation

Results of the field test:

- Significantly reduced questions over radio asking for wind updates
- Allowed for quicker measurements because the boat didn't need to be stopped
- Significantly increased the measurement frequency
- Increased accuracy of the measured direction

Missing capabilities and possible improvements

Currently missing are

- Position filtering with INS
- Data transmission using internal modem

Whereas these areas can still be improved upon:

- UI and UX of the data presentation
- NMEA2000 Library message support
- Local data access in case of missing mobile network coverage

Thanks for listening

Figure: First prototype

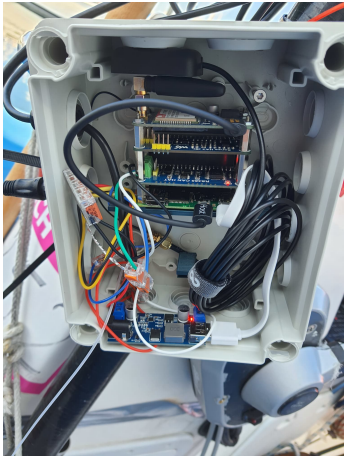

Figure: First prototype opened

Figure: Second prototype opened

Figure: System using yachting components

Figure: OWS-5 Monitoring System