

Bareboat Necessities (BBN) Boat Monitoring

mgrouch

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https://bareboat-necessities.github.io https://github.com/bareboat-necessities/lysmarine_gen/issues https://bareboat-necessities.wixsite.com/my-bareboat https://github.com/bareboat-necessities/bbn-m5stack-tough https://github.com/bareboat-necessities/bbn-nmea200-m5atom

PDF version:

https://bareboat-necessities.github.io/my-bareboat/bbn-boat-monitoring.pdf

Chapter 1. What is BBN Boat Monitoring

BBN Boat Monitoring is a low-power solution to send alarms on various conditions from an unattended boat.

In the center is esp32 with Ethernet module connected wired to a boat router. Alarms are sent via WhatsApp messenger.

Modular design of software and hardware so users can pick and choose needed modules.

M5Atom Lite (or Lite-S3) is the preferred hardware platform. It provides only one Grove-type of connector. So separate devices need to be designed. One for i2c sensors, one for NMEA 0183, and another one for NMEA 2000 inputs. And one more for digital/analog IO, 1-wire, and devices requiring IRQ line (ex: lightning detector AS3935) with M5Stack ATOM Mate extension kit allowing access the pins on the bottom of the ATOM board.

Chapter 2. Connectivity

- 1. MDNS discovery of other services gpsd, SignalK, pypilot, Victron MQTT, etc
- 2. DHCP client
- 3. NTP client
- 4. Web server for configuration
- 5. Uptime reporting (sleeping periods to save power)
- 6. Ethernet to router
- 7. NMEA 0183, NMEA 2000
- 8. i2c, 1-wire, UART, LoRa, Ethernet, other GPIO (analog and digital)
- 9. WhatsApp message
- 10. Command-line WhatsApp messenger for Linux
- 11. Internet connection speed reporting
- 12. Speakers / Buzzer for audible alarms?
- 13. Status lights for visual alarms?

Chapter 3. Hardware

esp32 on m5atom-lite or m5atom-lite-S3 from M5Stack. With M5Stack Ethernet AtomPoW (with w5500 chip).

Sensors (pick and choose):

• Accelerometer

M5Stack 3-Axis Digital Accelerometer Unit (ADXL345)

• IMU

M5Stack 6-DoF IMU Pro Mini Unit (BMI270, BMM150, BMP280)

or

M5Stack 6-Axis IMU Unit(MPU6886)

• Env sensors (temperature, barometer, humidity)

M5Stack ENV IV Unit with Temperature Humidity Air Pressure Sensor (SHT40+BMP280)

or

M5Stack ENV III Unit with Temperature Humidity Air Pressure Sensor (SHT30+QMP6988)

• Gas Sensors (CO, heavy gases, hydrogen, smoke detector)

Carbon monoxide sensor for esp32 (MQ-7 gas sensor?)

Smoke detector sensor for esp32 (MQ-2 gas sensor?)

Heavy gases sensor for esp32 (MQ-2/MQ-4/MQ-5/MQ-6 gas sensors?)

Hydrogen H2 gas detector sensor for esp32 (MQ-8 gas sensor?)

• GPS

M5Stack Mini GPS/BDS Unit (AT6558)

• NMEA 0183 interface

M5Stack Isolated RS485 Unit

• NMEA 2000 interface

M5Stack Isolated CANBus Unit (CA-IS3050G)

• Lightning sensor

Sparkfun LIGHTNING DETECTOR - AS3935

• Open Fire Flame sensor

Grove Flame YG1006 sensor

• Voltage sensor

M5Stack Voltmeter Unit (ADS1115)

• Current (amp) meter for bilge pump usage

M5Stack Ammeter Unit (ADS1115)

• Temperature (1w) sensors

Dallas 1-wire temperature sensors

• Motion detection sensors

M5Stack PIR Motion Sensor (AS312)

• Water salinity sensor

Water conductivity sensor

• Proximity sensors (hatch open/closed sensor)

M5Stack Hall Effect Unit (A3144E Hall Sensor)

or

Magnetic Reed door switch sensor

or

M5Stack Limit Switch Unit

• Snow / ice sensor

Rain and Snow Sensor Transmitter Weather Induction Detection Heating Anti-icing IP65

• Water level sensor

Water leak detector sensor

• Dinghy LoRa locator

LoRa receiver for esp32 (international band?)

• RTC clock

M5Stack Real Time Clock (RTC) Unit (HYM8563)

• Light Sensor

3.1. M5Stack Grove Port Color Conventions

- Red ports are I2C
- Black ports are I/O
- Blue ports are UART

3.2. M5Stack Accessories

• M5Stack ATOM Mate DIY Expansion Kit

M5Stack ATOM Mate - DIY Expansion Kit - for M5ATOM

• M5Stack ATOM Tail485

M5Stack ATOM Tail485 - RS485 Converter for ATOM

• M5Stack 1 to 3 HUB Expansion Unit for i2c

M5Stack 1 to 3 HUB Expansion Unit

• RS485 to TTL Converter Unit

M5Stack RS485 to TTL Converter Unit

• LEDs for status lights

M5Stack RGB LED Unit (SK6812)

• Speaker / Buzzer

M5Stack ATOM Echo Smart Speaker Development Kit

or

M5Stack Passive Buzzer Unit

Screw Terminal Block

M5Stack VH3.96 - 4Pin Transfer Module Unit

Grove-T Connector

M5Stack Grove-T Connector (5pcs)

• Button

M5Stack Mini Dual Button Unit

• Battery

M5Stack ATOM TailBat - Battery Accessory for ATOM

• PoE Injector

wt-gpoe-48v10w (or some other industrial with better wattage)

• PoE Splitter

M5Stack PoE Splitter

3.3. Low Power Consumption Router

LinoVision IOT R41 Mini Industrial 4G LTE Router with Low Power Consumption and GPS/RS232/RS485

https://linovision.com/products/iot-r41

Chapter 4. Alarms (planned)

- 1. Heavy gases in bilge
- 2. High salinity of water in bilge
- 3. Hydrogen gas alarm
- 4. Fire alarm. Smoke detector
- 5. Open flames detected
- 6. Carbon monoxide alarm
- 7. Hatch open
- 8. High heel or pitch (from IMU)
- 9. High wind alarm
- 10. Lightning storm detected
- 11. Forgot nav lights 'on'
- 12. Motion detected (Intrusion)
- 13. High humidity
- 14. Possible fog conditions
- 15. Snow or ice conditions
- 16. Barometer keeps falling
- 17. Temp alarm (ex: fridge warm)
- 18. Dingy too far
- 19. GPX fix lost
- 20. High current at anchor (by speed through water)
- 21. Low water under keel alarm
- 22. Accelerometer alarm for high waves
- 23. Anchor alarm (plus command line utility to activate and deactivate)
- 24. Grounding alarm from accelerometer
- 25. Hard impact on hull (via accelerometer)
- 26. Heartbeat (ImAlive) message
- 27. Low battery voltage
- 28. Battery overcharging
- 29. High battery temperature
- 30. Shore power loss

- 31. Bilge pump high utilization
- 32. High water in bilge
- 33. Location reporting
- 34. Alarms from Victron MQTT

Chapter 5. Machine Learning Ideas

5.1. Using IMU

Use IMU to detect different events

- Boat groundings
- An object hitting hull
- Collision
- Walrus climbs your boat
- Someone boards your boat from dinghy
- Wave height calculation
- Line caught in the prop

5.2. Using Microphone

- Orca approach
- Detect whale songs, dolphins, etc
- Detect pistol shrimp
- Detect underwater sound of prop (approaching or moving away power vessels)
- Marine hydrophone listening

5.3. Using Cameras

- Plankton classification
- LIDAR
- Augmented reality marine applications
- Waves recording in 3D

Chapter 6. Compare to commercial solutions

Examples:

Trek Transponder Boat alarm and boat monitor systems https://www.trektransponder.com.au/

Glomex ZigBoat https://www.zigboat.com/

Maretron MBB300C vessel monitoring and control black box https://dev.maretron.com/products/ mbb300c.php

Siren Marine https://sirenmarine.com/