Bareboat Necessities (BBN) Boat Monitoring

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https://bareboat-necessities.github.io

https://github.com/bareboat-necessities/lysmarine_gen

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).

Software platform - EspHome: https://esphome.io/

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**

  M5Stack Dlight Unit - Ambient Light Sensor (BH1750FVI-TR)

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/