

Programming Environment and Architecture for Situational Awareness and Response*

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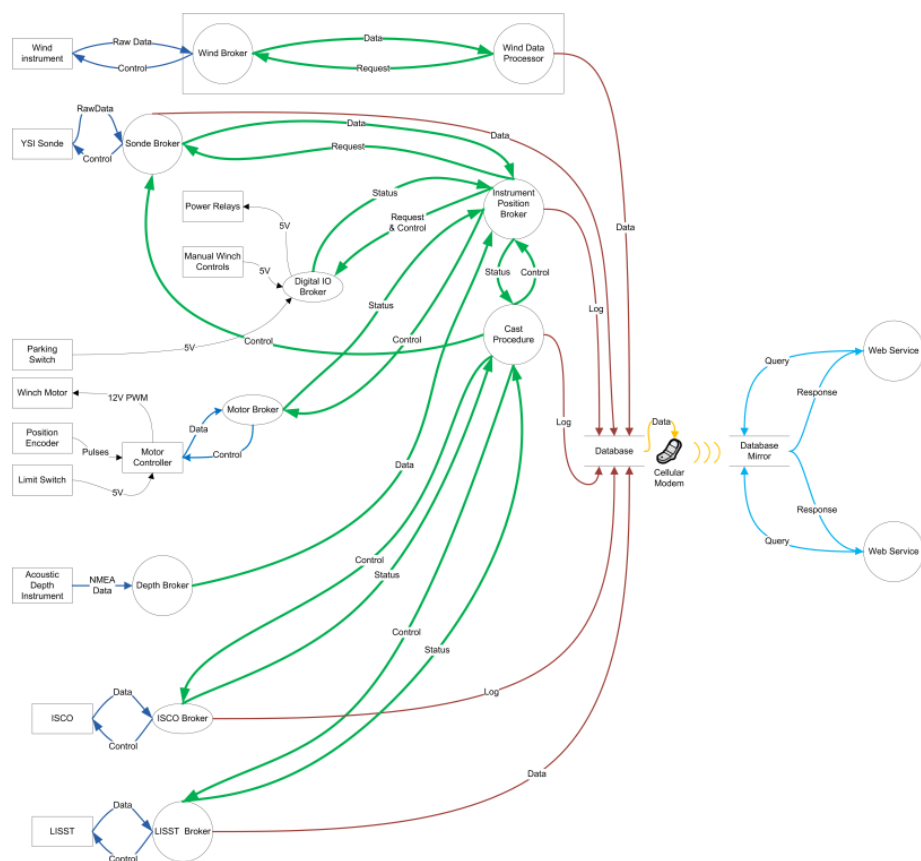
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(In collaboration with James Horey, ORNL)



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RENCI's Standard Approach for Sensing Platforms



- Low-power embedded Linux processor, solid state disk
- Additional microcontrollers
- 3G modem
- On-board database: SQLite, PostgreSQL
- Synchronize platform DB with base RDBMS
- Analysis and decision support layers query RDBMS
- Geo-referenced data displayed on The Big Board; client apps use web services
- Can we do better?

Rapidly deployable, Robust, Real-time Situational Awareness and Response (R³SAR)

Goal: Improve programming productivity for sensing and sense/react systems

- Efficient design and deployment; reduced costs in hardware, labor and operation
- Timely delivery of the right results

Driving Problems: Environmental sense/react

- Civil response to environmental emergencies: fire, flood, wind, etc.
- DHS and DoD problems
- Cost-effective sensing for field sciences

General Approach: Explore and extend data-oriented, declarative abstractions

- Relational data
- Composable, streaming “pipelines and filters” implementations
- Abstract “overlay networks” for communication
- QoS constraints and properties
- Optional lossy filtering
- Annotation of plug-n-play components

Activities

- Evaluation and (re-)design of symbiotic project software
- Comparative evaluation of distributed-system programming languages/models for sense/react systems
- Control interface for “Tables” on Android mobile devices
- Video streaming and filtering pipeline for “Bird feeder monitoring and response”
- Android-based control system for multi-camera sensing experiments
- Prototyping of Android-compatible communication layer based on OMQ

Meanwhile...

- Explosion of handhelds and tablets
- New mobile platforms are leading to the ephemeralization of sensors
- How can a small research project “ride the wave” in an area that’s so important and timely?

Symbiotic Projects & Driving Problems

Automated Vertical Profiler Buoy



- Multi-parameter (T, salinity, turbidity, depth) sonde
- Water sampler/lab
- GPS
- Precision winch with depth indexing
- Low-power x86 controller with SSD
- On-platform PostgreSQL
- Cell modem connectivity to server

RENCI Road Surface Temperature Thing (RRSTT)

- Vehicle-mounted monitoring of rural road conditions
- ARM-based Linux platform
- IR emissivity road surface temperature sensor
- GPS receiver
- 3G modem
- User interfaces for Big Board, web and mobile
- To be mounted on public safety vehicles, school buses, etc.
- Provides information on which roads should be salted or plowed, and whether school should be cancelled



A Mobile Micro Rain Radar



- 50mw vertical Doppler radar sounder
- Laser disdrometer (precipitation size, velocity, phase)
- Automated weather station
- GPS
- 3G modem
- Auto-leveling stabilizers for rapid setup
- Ice storm warning for government and public utility responders; provides data for calibration of WRF atmosphere model by NOAA

The Big Board

- Visualization wall for situational awareness
- Base map + state orthophotos
- Database/GIS interfaces
- Interactive annotations
- Mobile interfaces

