Team 16: Next-Gen RFID PIT Platform for Fish Tracking and IoT Integration

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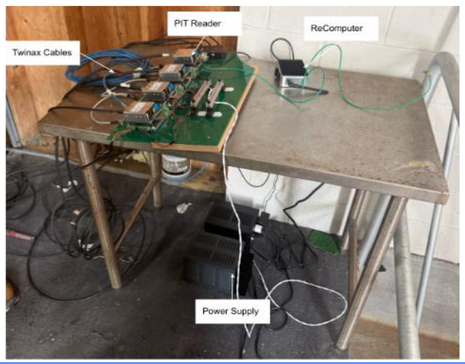
Background

The FishPass system uses passive integrated transponder (PIT) tags implanted in fish to track their movement through waterways. When a tagged fish swims through a submerged antenna coil tuned to 134 kHz, the PIT reader detects the tag and sends the data to a central computer through RS-232 communication.

Current System

The existing prototype consists of four PIT readers mounted on an open board with loose wiring and exposed twinaxial cables. RS-232 lines are routed to an external USB-to-serial hub, and the standalone power supply has unmanaged cabling. Because the system has no enclosure, it is vulnerable to weather and accidental contact. Connector reliability issues and poor cable management make the system difficult to maintain and unsuitable for extended field use.



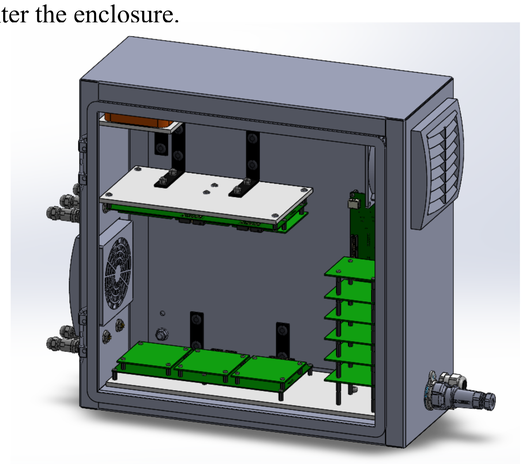
Key Specifications

- Power the system from an external 12V power supply
- Scan in PIT tags that pass through the antennas
- Send the tag data through RS232 serial connections
- Locally store the fish tag data on a computer
- Allow for remote desktop access to the local computer
- Allow for a file download of the scanned fish tag data
- Have robust wiring that can withstand non-malicious interactions
  - Create a custom PCB(s)
- Have a robust enclosure
- Have quick disconnect cable connections
- Allow for easy troubleshooting for technicians

Physical Design

Mechanical Design

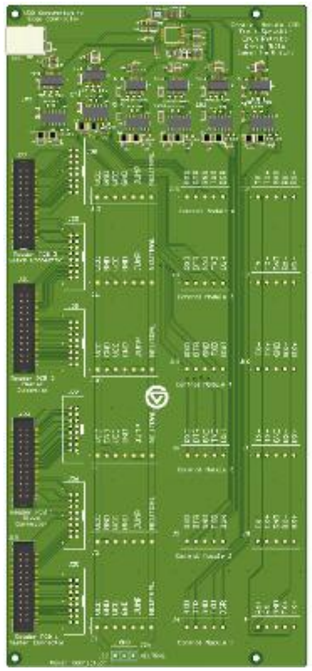
The redesigned system uses a steel enclosure measuring 20 x 20 x 8 inches to protect all components from environmental hazards. A mounting plate inside the enclosure support three ABS shelves that hold the ElastBox computer, the reader PCBs, and the six control modules. The shelves are secured using riveted L-brackets. A 12V powered fan and passive vent create a left-to-right airflow path that maintain safe operating temperatures across all heat generating components. A circular three-pin connector provides the main power connector while a cable gland allows the ElastBox400 power cable to enter the enclosure.



PCB Design

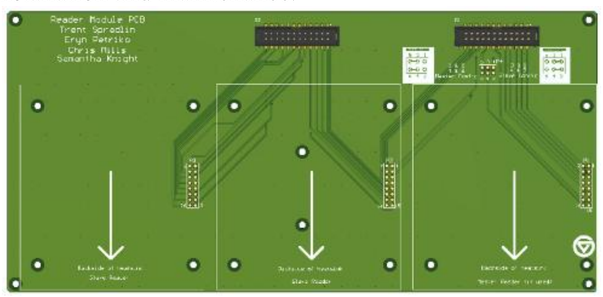
Control Module

The control module PCB supports up to six reader control modules and consolidates power, RS-232 communication, and synchronization signals. It uses MAX3232 transceivers, FT231XS USB converters, and an FE2.1 USB hub to combine all reader outputs into a single USB-B connection. This design eliminates long wiring runs, reduces failure points, and simplifies technician troubleshooting.



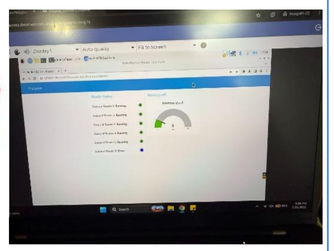
Reader Module PCB

Each reader module PCB supports up to three PIT readers. Two were used to support a total of six PIT readers. Each reader mounts directly to the PCB using 16-pin headers and standoffs, eliminating loose cables. Jumper-selectable master and slave configurations allow for flexible system setup, and silkscreen labels guide technicians during installation and maintenance.



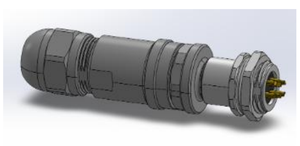
Software Design

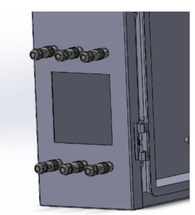
The software components are managed by the ElastBox400 using several supporting programs. The ElastBox400 includes 4G connectivity, allowing the entire system to be monitored remotely. DWService provides flexible remote-access and monitoring capabilities. The system also employs Syncthing to send collected data from the ElastBox400 to connected computers over the internet. Remote access to PIT reader status is provided through a Node-RED GUI that receives updates from the main Python script. This script collects data from the PIT readers, creates and organizes data files, and sends reader status information to the GUI.



Connector Design

Panel-mounted M12 D-coded twin-axial connectors provide secure and reliable connections between the six external antennas and the PIT readers. The connectors use a front-mount design, allowing them to be installed from outside the enclosure and secured internally with a locking nut. Their threaded coupling prevents accidental disconnection while still allowing tool-free removal for installation and maintenance.





Acknowledgements

Advisors: Dr. Karl Brakora, Dr. Philip Hittepole, Dr. Chris Pung
Sponsor: Dan Zielinski