PenGUI

Winter Design Review

What is PenGUI?

- Working with Praevium Research, Inc., a Goleta-based company that researches and develops tunable lasers
- Task: redesign their developer kit user interface, replacing a previous web server approach
- Goal: make the developer kit as **user friendly, functional, and extensible** as possible, while keeping it **fully offline** (for practical and security reasons)
- The Product: a self contained kit used by researchers and developers to experiment with a tunable laser for their application

Applications

- Imaging
  - Non-invasive medical imaging without X-ray e.g. OCT
  - Non-destructive imaging in fragile parts e.g. batteries
- Raman Spectroscopy
  - Chemical detection (e.g. gas detection or mixture composition analysis)
  - Non-invasive glucose monitoring
- Fiber Optic Shape Sensing
  - Structural health monitoring
  - Aerospace
  - Surgical navigation
- LiDAR
- Optical data communication and storage

Development Team
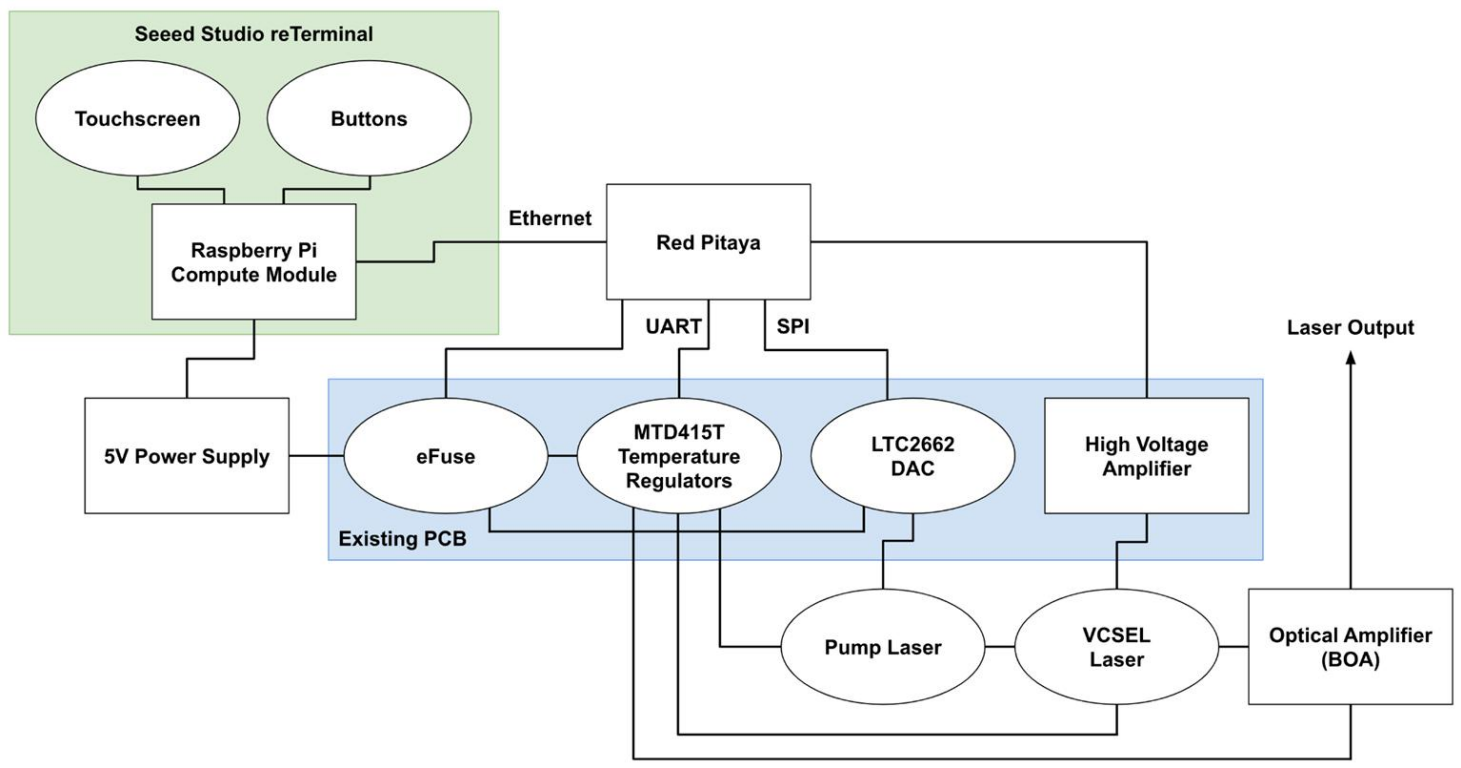
Ayush Shah

Torin Schlunk

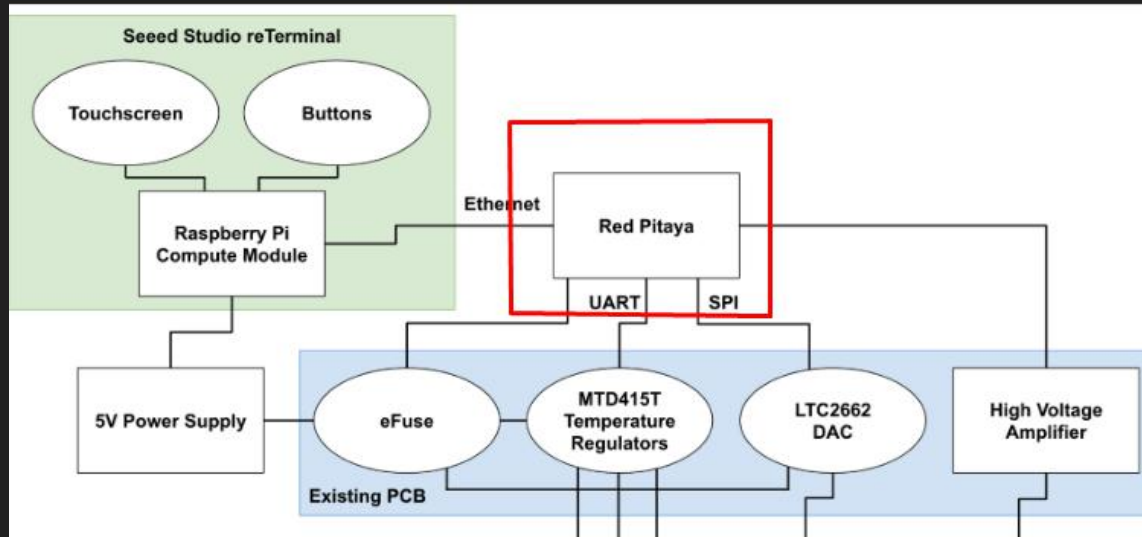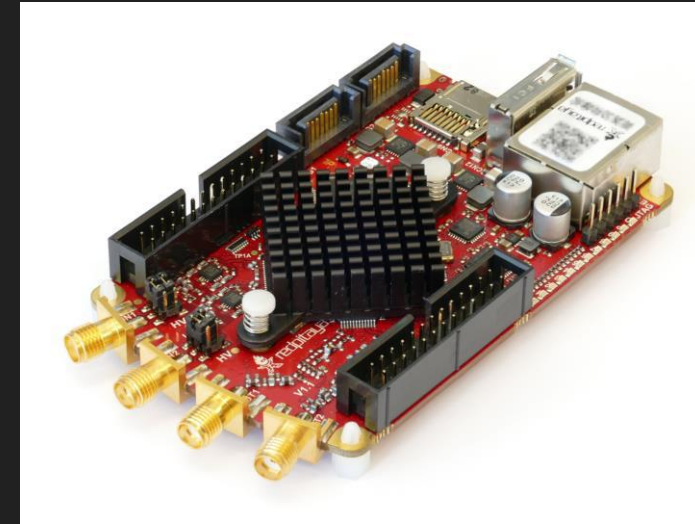Team Lead

Simon Lai

Rylan Pow

Rodney Li

Block Diagram

Components

- Red Pitaya

- Seed Studio reTerminal
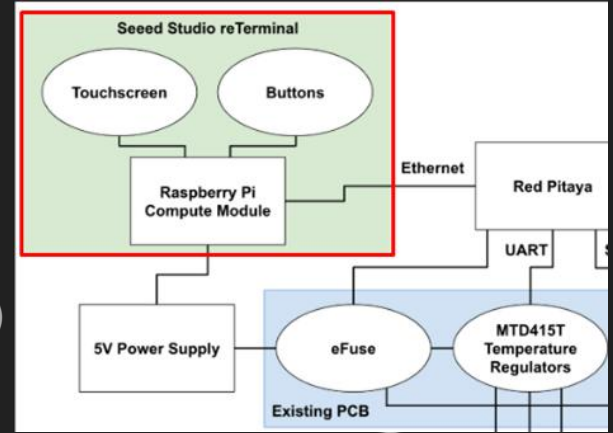
- Praevium DevKit/VSCEL

Components - Red Pitaya

- "The Swiss Army Knife For Engineers" - Very powerful board
- On-board FPGA
- Used to control the VCSEL

Components - Seed Studio reTerminal

- Off-the-shelf component
- Contains a Raspberry Pi Compute Module
- Touchscreen support
- Ethernet Port (wireless connection supported too)
- USB Port
- Serves as an interface between user and the Red Pitaya/Laser

Components - Praevium Enclosure for DevKit

- Houses the entire Devkit that controls the VCSEL
  - Devkit: laser, Red Pitaya, PCB
- Designed by Praevium team
- Originally not designed for reTerminal integration
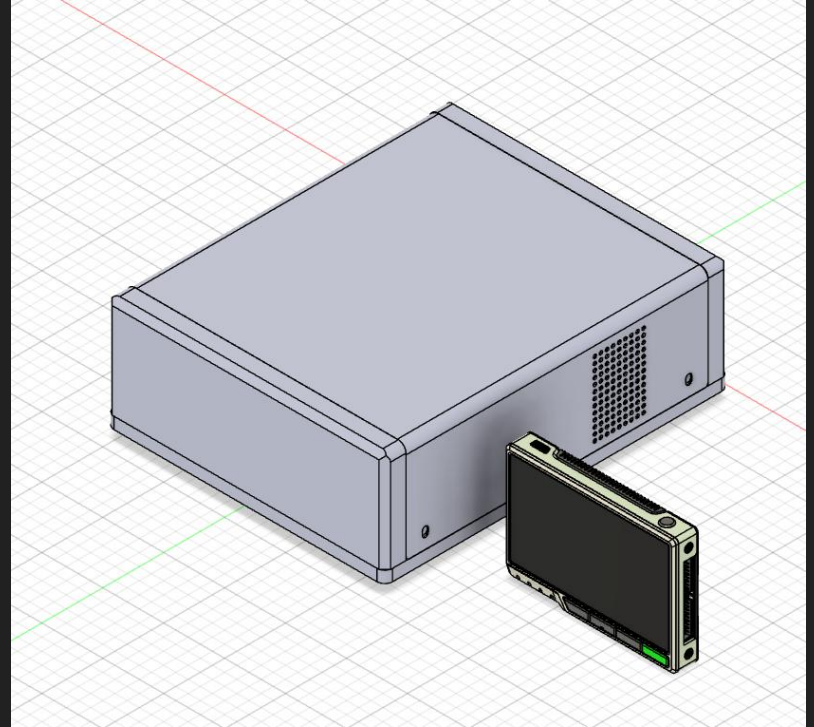
Components - Praevium Devkit/VCSEL

- "Vertical Cavity Surface Emitting Laser"
  - Gas, Solid-State, Fiber, Semiconductor/"Diode" Lasers(Edge emitting and VCSELs
- Uses as listed earlier
  - imaging, spectroscopy, LiDAR, etc
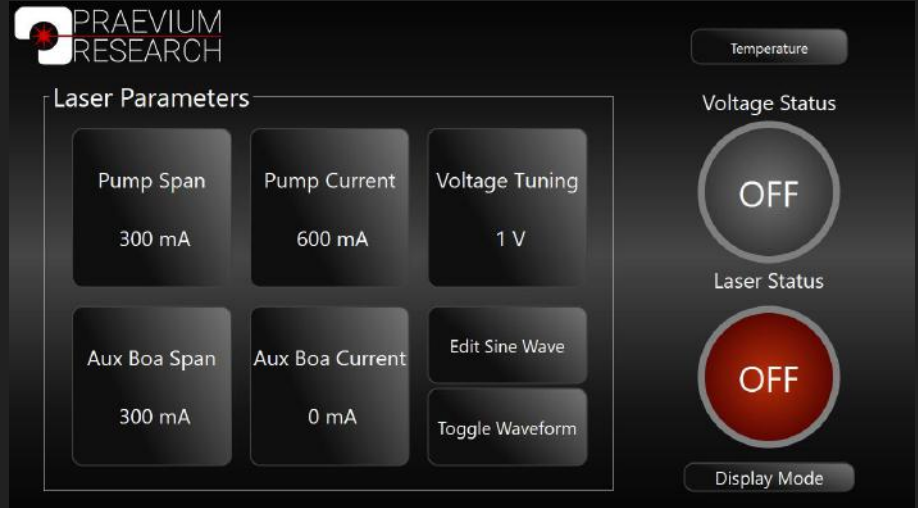- Designed by Praevium
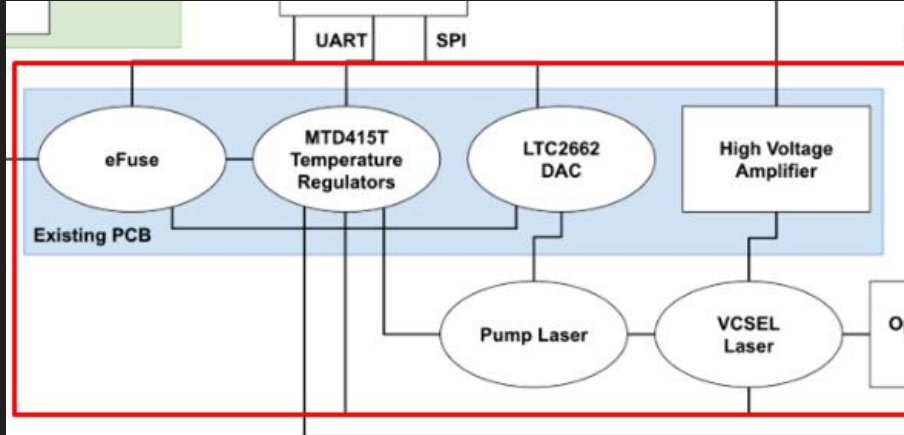
Current Progress - GUI

- Refined user interface and user experience

- Added voltage and laser status toggles

- Added waveform generator

- Added temperature sensing and control
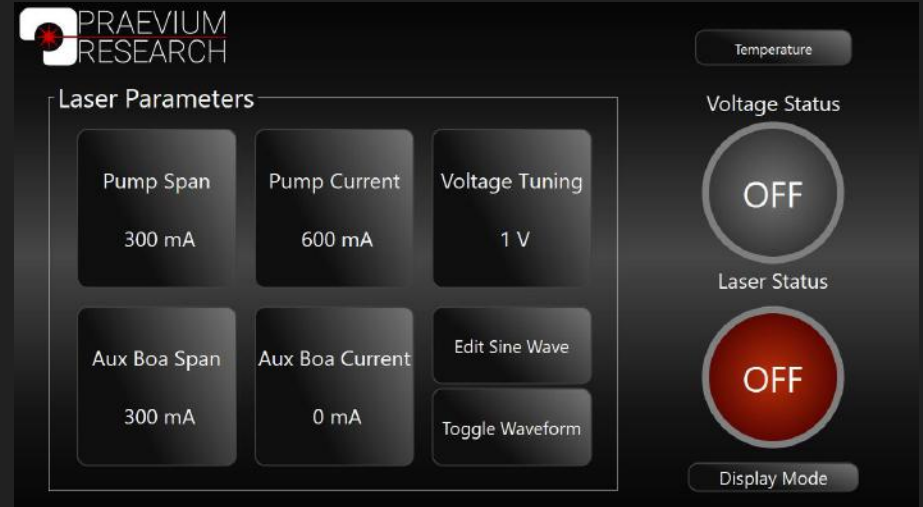
Current Progress - GUI

- Overall improved aesthetics (Carbon Theme)

Current Progress - Waveform and Temperature Editing

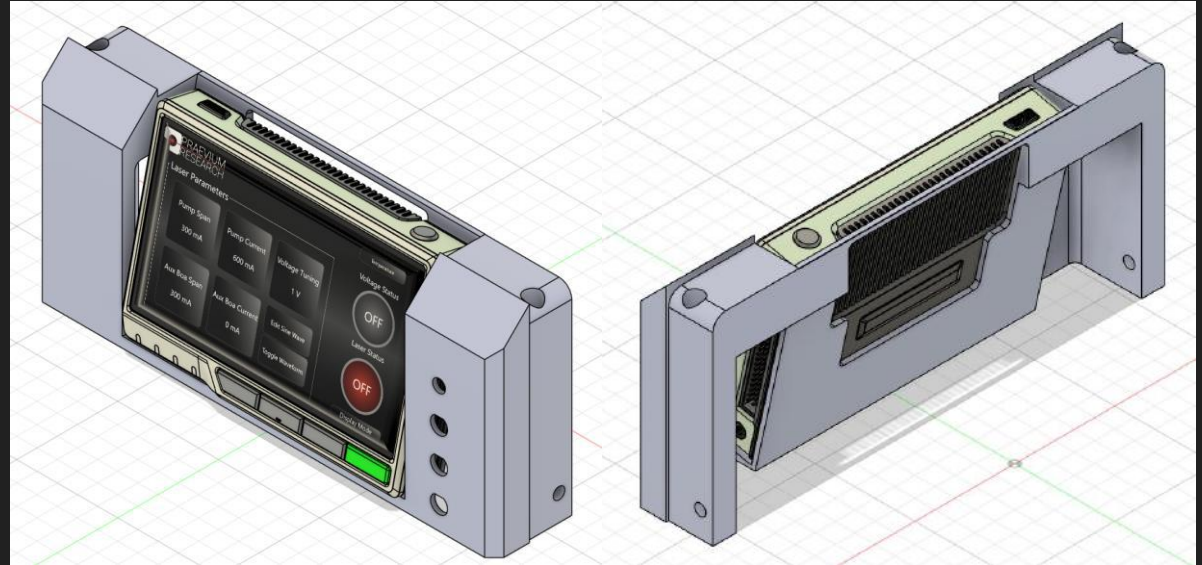- Allows for Sine Wave and temperature manipulation

Current Progress - Dev Kit Frame

- New prototype modeled dev kit frame to support the reTerminal integration

Current Progress - Other Frame Prototypes

- More Prototyping: integrating wiring/port paths, including a PCB connection

Current Progress – Red Pitaya Replacement

Custom PCB currently in design phase to allow reTerminal to directly control the driver board.

DAC is needed to perform some low-speed signal generation. Candidate DAC, AD354xR evaluation board is undergoing testing for functionality and performance.

Current Progress – Communication

● Parameter changes and waveforms are correctly generated

Successful Testing

Current Progress – Communication

- Data being encoded as a JSON and sent from the reTerminal to the Red Pitaya over ethernet upon GUI button press

- Temperature is sent and received through UART on the driver board, and is now able to be controlled and feedback displayed on the reTerminal

Schedule

- Wrap up GUI, collect detailed feedback, and author documentation for potential future amendments

- Complete PCB design and integration

- Demoing for the Spring Quarter: Shape sensing, Spectroscopy, Imaging

Risk Analysis

- reTerminal long term durability

- Usefulness of replacing FPGA considering limited GPIO update frequency

Special Thanks

Chris, Bernie, Calisto, Anthony, Colin, and all the staff at Praevium Research

Professor Yogananda

TA Alex