Exam Collector

SDDEC22-04
Advising Profesor - Dr. Bigelow

Problem

- Return to in-person classes
  - Disease transmission
  - Physical exam submissions

- Hands-free sanitation device

- Keep track of which students have submitted their exams

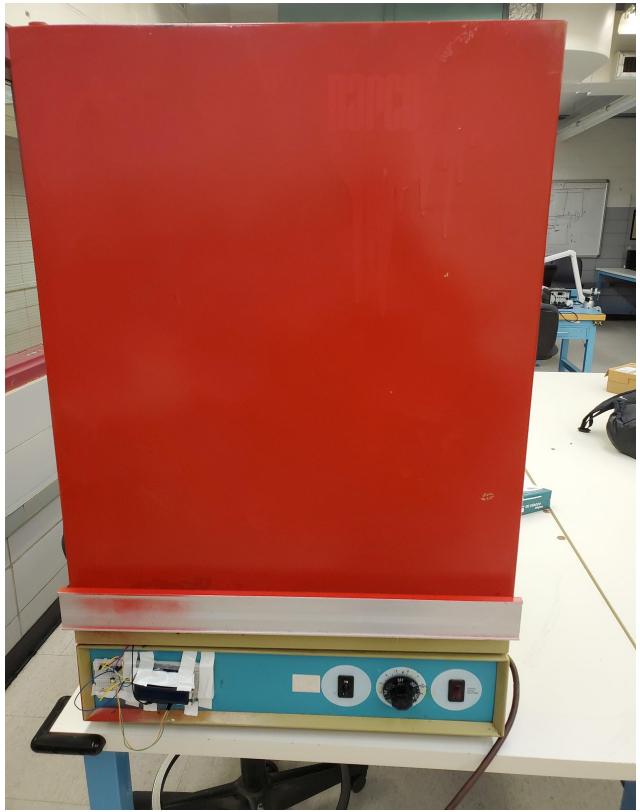
RESEARCH

- Possible Methods
  - UV Light
  - Heating
  - Cleaning Solutions
- Per CDC guidelines: Pathogens including Covid-19, can last anywhere from a few hours to a few days depending on the pathogen.
- When paper is heated at 70 degrees celsius for 15 minutes, Pathogens are destroyed.

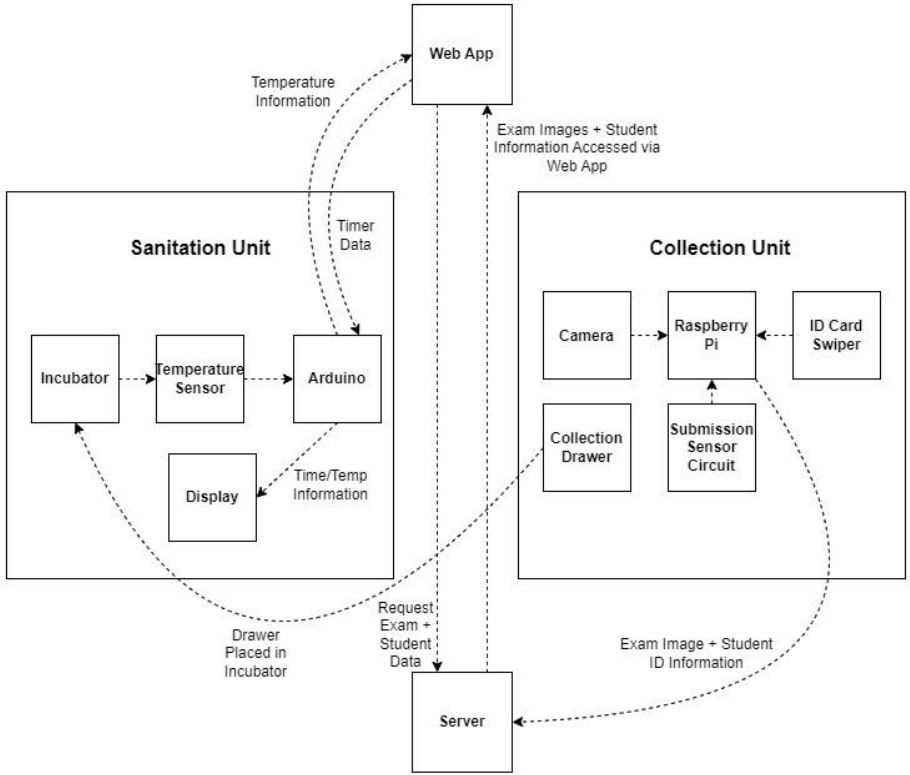
INITIAL DESIGN

- Original plan was an All-in-One box
- As scope grew, This design would be too heavy to be mobile
- Decision was made to split into two boxes.

Our Solution



TOP DOWN


Web App
Temperature Information
Timer Data
Exam Images + Student Information Accessed via Web App
Sanitation Unit
Incubator
Temperature Sensor
Arduino
Display
Time/Temp Information
Collection Unit
Camera
Raspberry Pi
ID Card Swiper
Collection Drawer
Submission Sensor Circuit
Drawer Placed in Incubator
Request Exam + Student Data
Exam Image + Student ID Information
Server

Functional and Non-functional Requirements

Functional:

- Heat papers to 70°C (in a timely manner)
- Contact free intake
- some way to record students who submit an exam
- Timer that alerts users when cycle is complete.

Non-Functional:

- Adjust temperature inside the chamber.
- Multiple shelves.

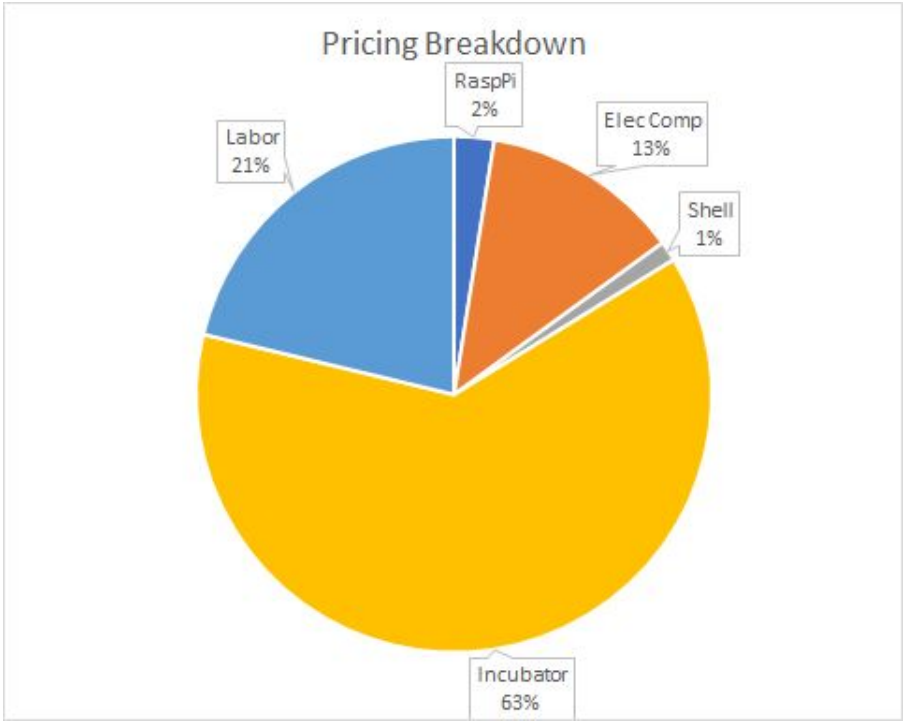
Technical Constraints

Must not set exams on fire (Safety constraint)

Materials should be cost effective (Economic constraint)

Cash Flow Statement

- Fabrication Costs
  - Incubator Unit
  - Collector Shell
  - Microcontroller
  - Other electrical components
  - Labor
- Annual Expenses
  - Maintenance
  - Electricity
- Possible Annual Revenues
  - Rent

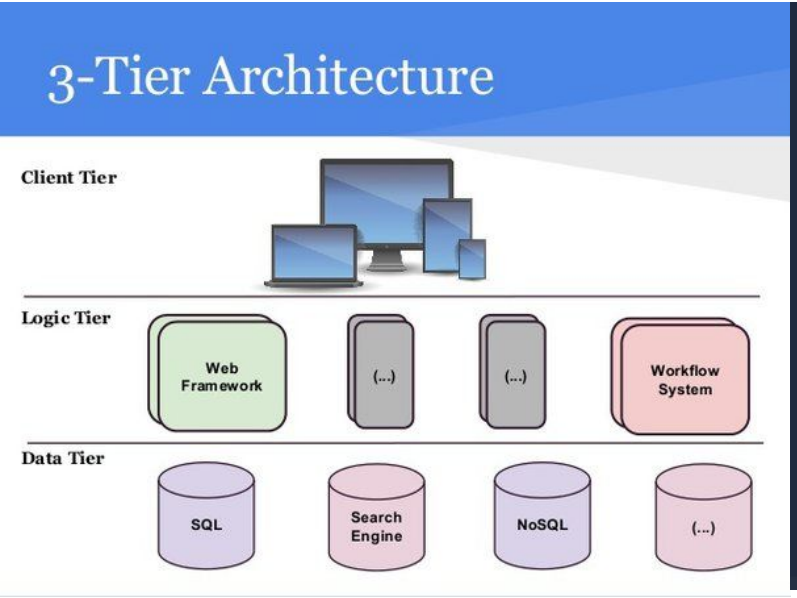


Tests Completed

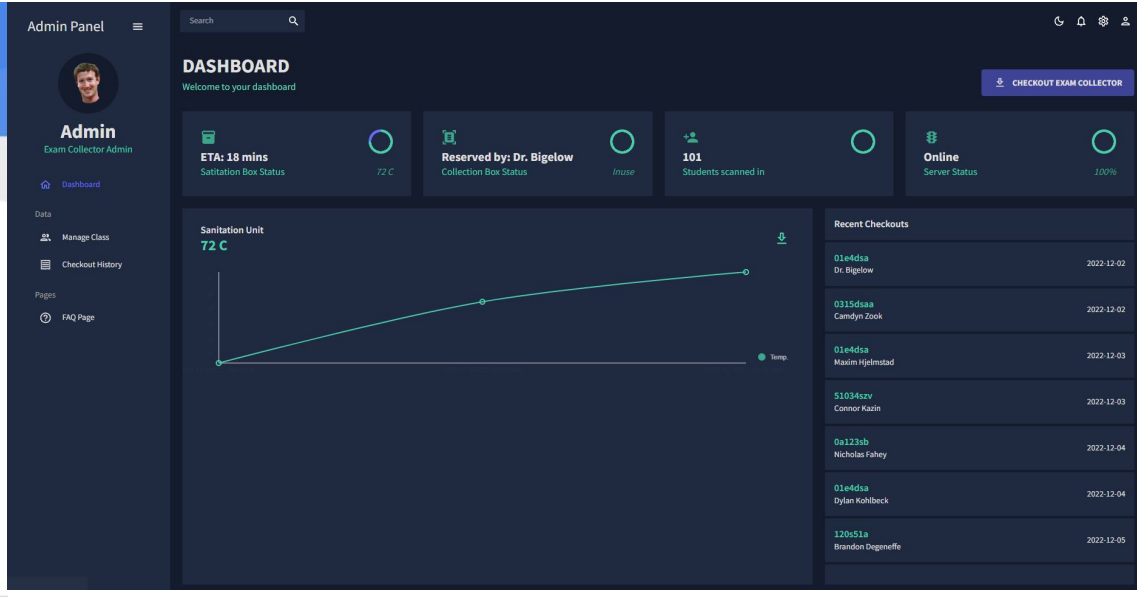
- Multiple Sanitation tests have been completed to assure temperature inside the Incubator is consistent with CDC guidelines.
- Temperature sensor was added to the middle of the stack of exams to see when the middle of the stack reached 70 degrees C.
- Web application used a series of Python unit tests
- Collection Box functionality was tested manually

Web App Design

- 3-tiered Website Design



- Administrative Dashboard



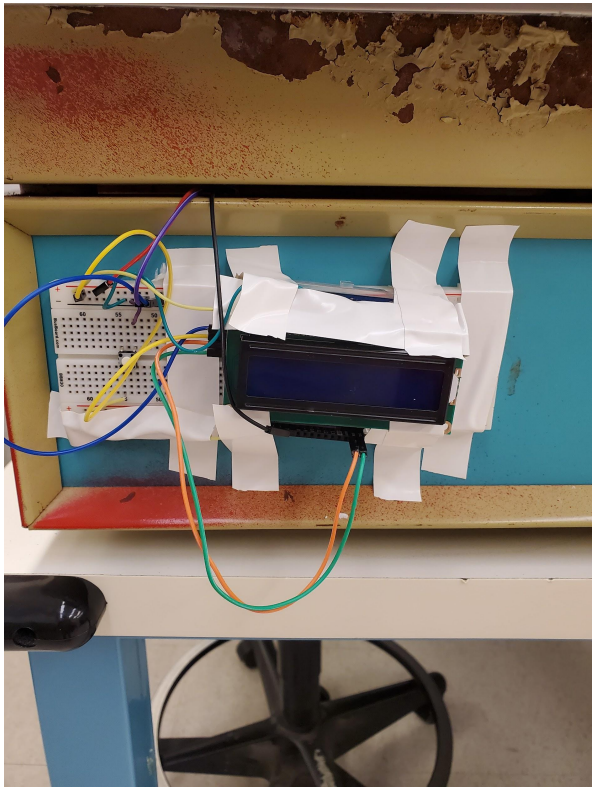
Functionality: Teachers can checkout the collection/sanitation box, download exam data (when collection box finishes), See checkout History and calendar, and See Sanitation Box Status.

Sanitation Unit

- NAPCO 320 Incubator
- Safety Features
  - Max temp of 120 degrees Celsius
  - Napco Incubators use thermistor circuits to prevent overheating
- Hardware:
  - DHT22 Temperature Sensor
  - Arduino Uno Wifi Rev 2
  - Sunfounder 16x2 LCD screen with I2C module
  - Parallax 360 continuous servo (non-functional)

Temperature Sensor Circuit

- Functionality:
  - Records temperature inside Incubator
    - Prints values to LCD and uploads to Web App
    - Begins Timer Countdown when proper temperature is reached
  - Upon Button Push
    - Program runs
- Technical Challenges
  - Bypassing wifi security on Arduino
  - Functionality of the servo



Collection Unit

- Modified printer shell
- Chosen for its size and specs
- Modifications included mounting RaspPi and Light sensor.

Card Swiper

- Allows for Students to Swipe University ID,

  Records ID number

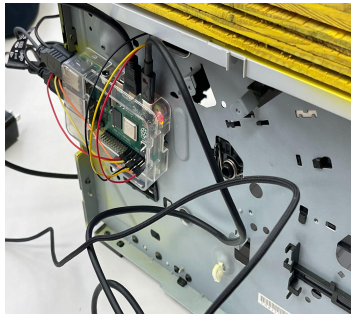
- Saves a list that is sent to server

- Challenges: Making it work in conjunction with

  The light sensor.

Collection Unit MCU

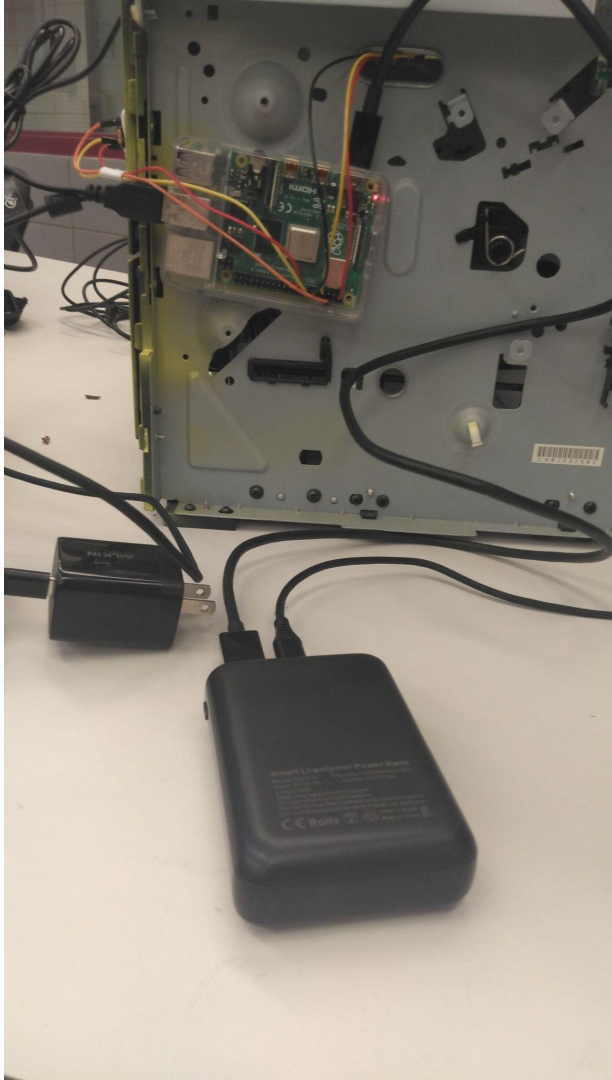
- RaspberryPi
- Image Capture
  - LDR circuit detects when exam has been inserted
  - Signal from GPIO pins initiates image capture
- Card Swiper
  - Card information written to CSV
- File Transfer
  - All images and CSV sent to ZIP file
  - TCP Client program on RaspberryPi sends ZIP file to TCP Server
- Challenges
  - Timing, Simultaneous Image/ID Capture



Collection Unit Power Supply

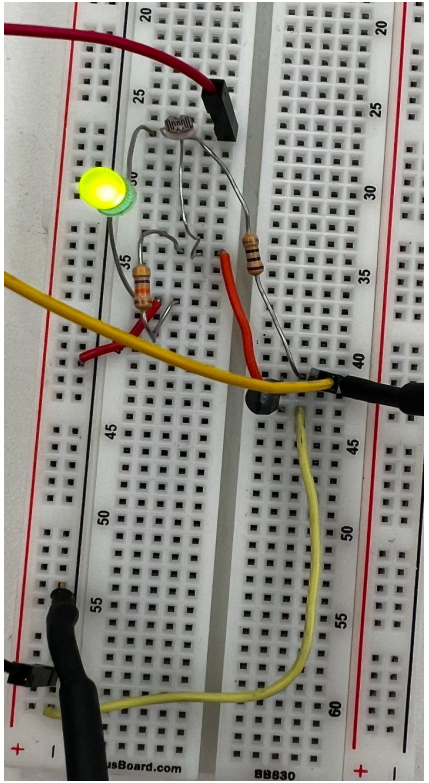
- Typical batteries insufficient
  - Batteries need to be replaced after each use
  - High cost of operation over time

- Rechargeable power supply that lasts up to 4 hours
  - Modified cell phone external battery + adapters



Collection Unit Light Sensor

- Hardware:
  - Light-Emitting Diode (1)
  - 10 Ω resistor (1)
  - 47 kΩ resistor (1)
  - 1 - 4 kΩ Light Dependent resistor (1)
  - 2222A BJT (1)
- Functionality
  - Detects an exam submission
  - Provides light for the LDR when no exams are being submitted to prevent photo capturing.
  - When LDR is covered it alters the voltage connected to the GPIO pin to allow camera capturing.



Project Demo