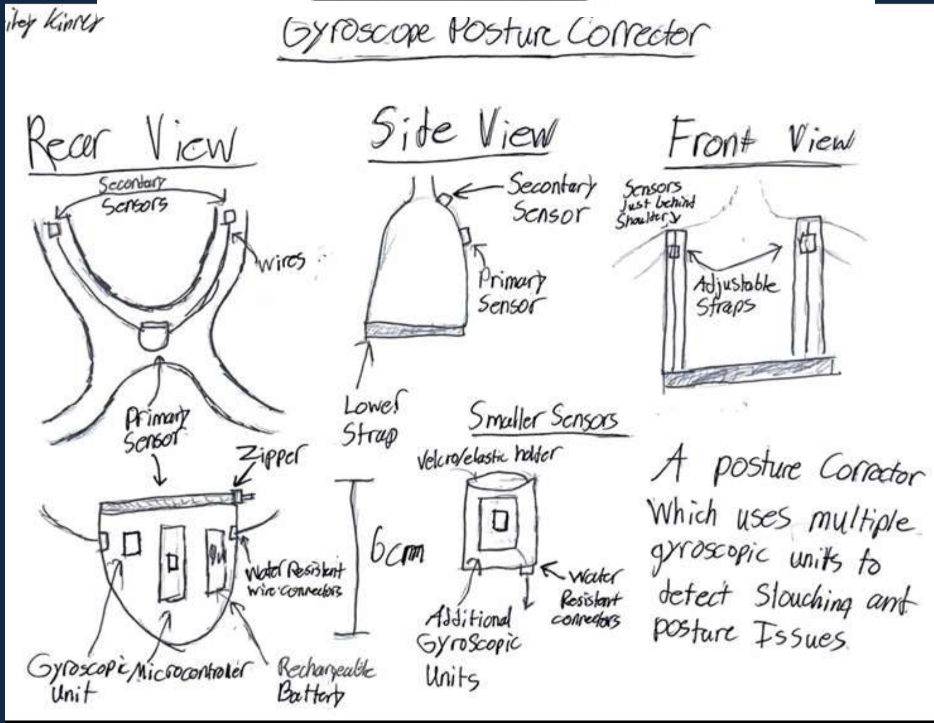
SELF-GUIDED ENGINEERING PORTFOLIO

# Bailey Kinney

Robotics, autonomous control, wearable sensing, and iterative prototyping

**This deck is designed to be read without a presenter.**

Industrial Engineering | Western New England University



# How I approach engineering

I prefer projects where mechanical design, controls, data, and testing affect one another.

## Build

- CAD for functional parts
- Electronics integration
- Rapid physical prototypes

## Program

- Python and MicroPython
- Sensor-driven control
- Filtering and failsafes

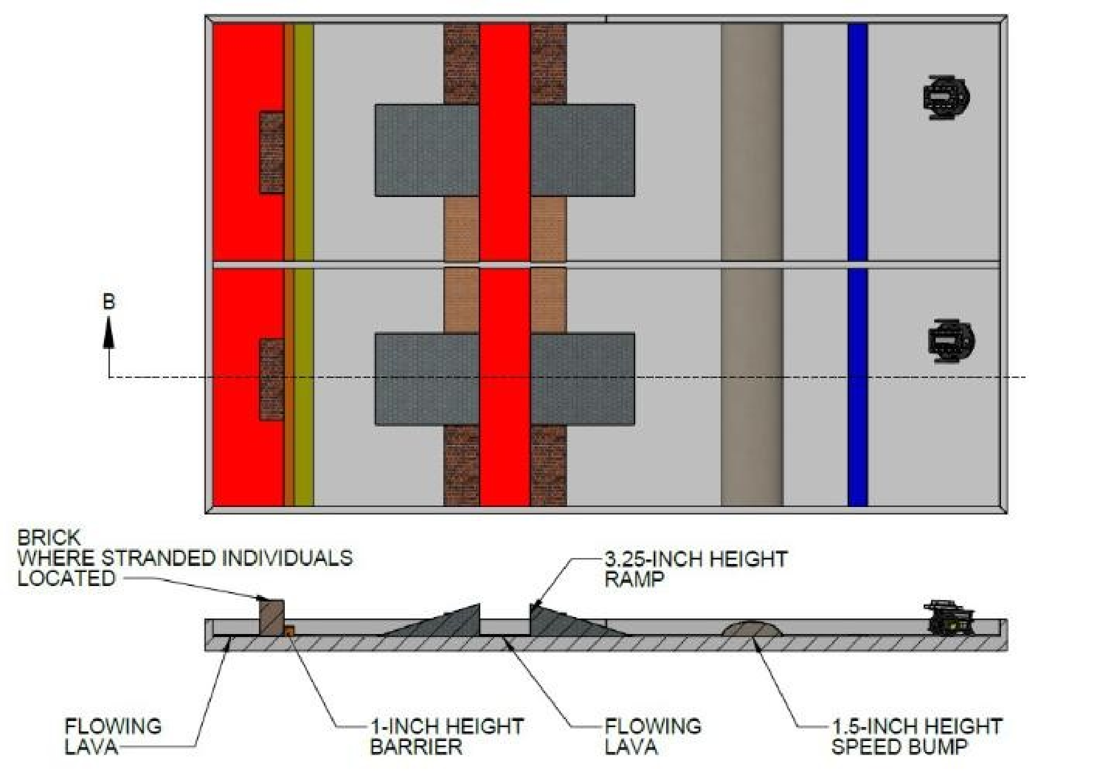
## Improve

- Test under real constraints
- Find the failure mode
- Simplify the next design

**The following projects show that process in two different systems.**

# Bot Bash: two rescue robots and one autonomous robot

The competition combined mechanical obstacles, target retrieval, timing, and autonomous navigation.




## System scope

- Bridge Bot: cross the initial obstacle and place a bridge over the gap
- Rescue Bot: traverse the bridge, collect a stranded figure, and return
- Autonomous Bot: navigate a maze using three IR sensors and stop near the course edge

**Competition constraints included a 1.5-inch bump, a 5-inch gap, a four-minute limit, and no lava contact.**

# My contribution combined leadership, CAD, and programming

I helped lead the team and owned major portions of the rescue and autonomous systems.

## Rescue Bot

- Designed the rescue ramp
- Designed the sweep arm
- Designed the servo holder
- Programmed the robot
- Worked on arm reliability

## Autonomous Bot

- Designed the IR holder
- Completed nearly all programming
- Implemented sensing, decisions, failsafes, and stopping
- Operated the robot

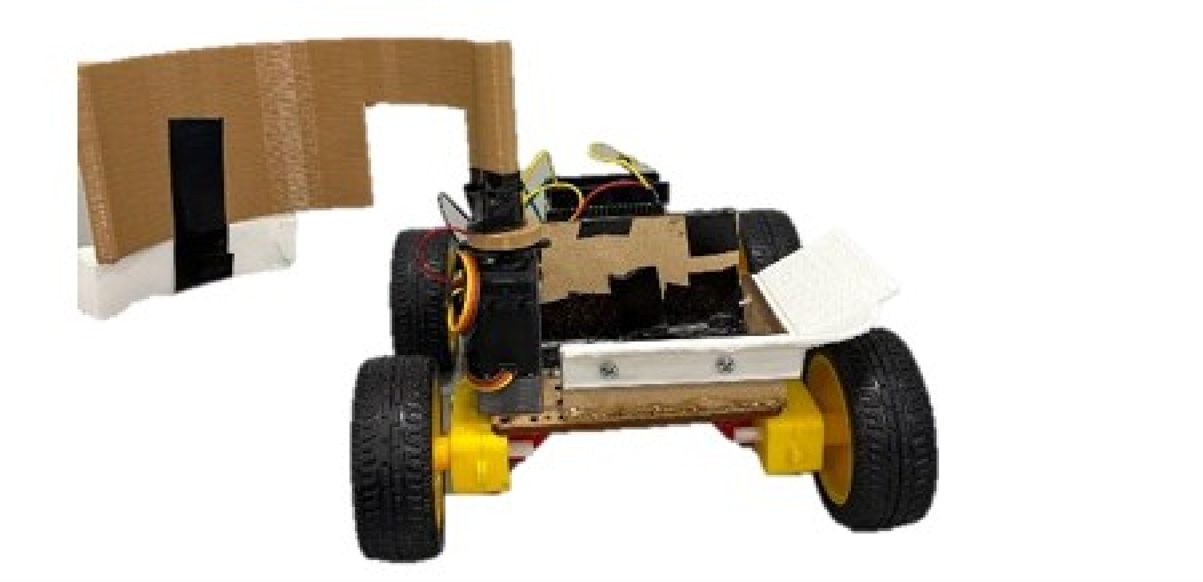
## Team Work

- Helped lead the project
- Participated in testing
- Contributed to documentation
- Presented with the full team to judges

# Rescue reliability improved through a simpler collection motion

The original lifting concept struggled with alignment. The final design swept figures into a basket.

*Earlier rescue-arm prototype: pickup geometry and alignment were unreliable.*



*Final rescue mechanism: a servo-driven sweep arm pushed targets into the basket.*

# The autonomous robot was my heaviest technical contribution

I implemented the full sensor-to-motion control loop and the recovery logic around it.

### Sense

Three IR sensors
Calibration
Distance readings

### Decide

Direction selection
Turn-counter memory
Failsafe conditions

### Act

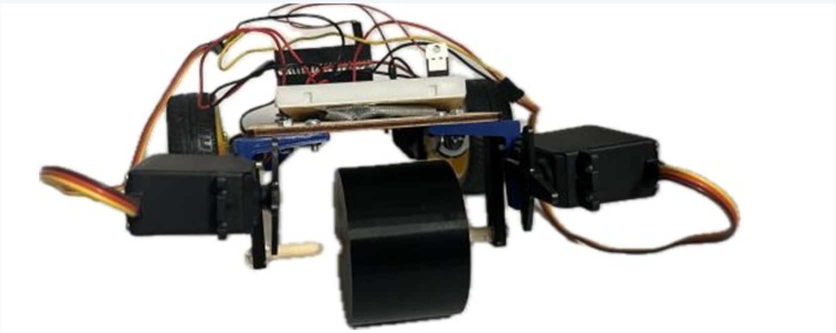
Motor control
Slow turns
Cliff stopping

**The turn counter acted as limited memory, helping the robot detect repeated turning and escape stuck conditions.**

# Competition performance

Testing established the potential speed; competition results showed real course performance.

| 1:04 | ~15 sec | 34 sec | 1st |
|---|---|---|---|
| DP1 competition run | Autonomous best test run | Autonomous competition run | Presentation category |



*Bridge robot with enlarged front wheel used to improve obstacle clearance.*

## What the results show

- The rescue system completed all listed DP1 objectives during the 1:04 competition run
- The autonomous robot ran faster in testing than under competition conditions
- The team placed fifth overall and each member presented to judges

# Posture+: wearable sensing and haptic feedback

The project compared upper- and lower-back orientation instead of relying on one sensor alone.

*Problem-context image used in the original project presentation.*

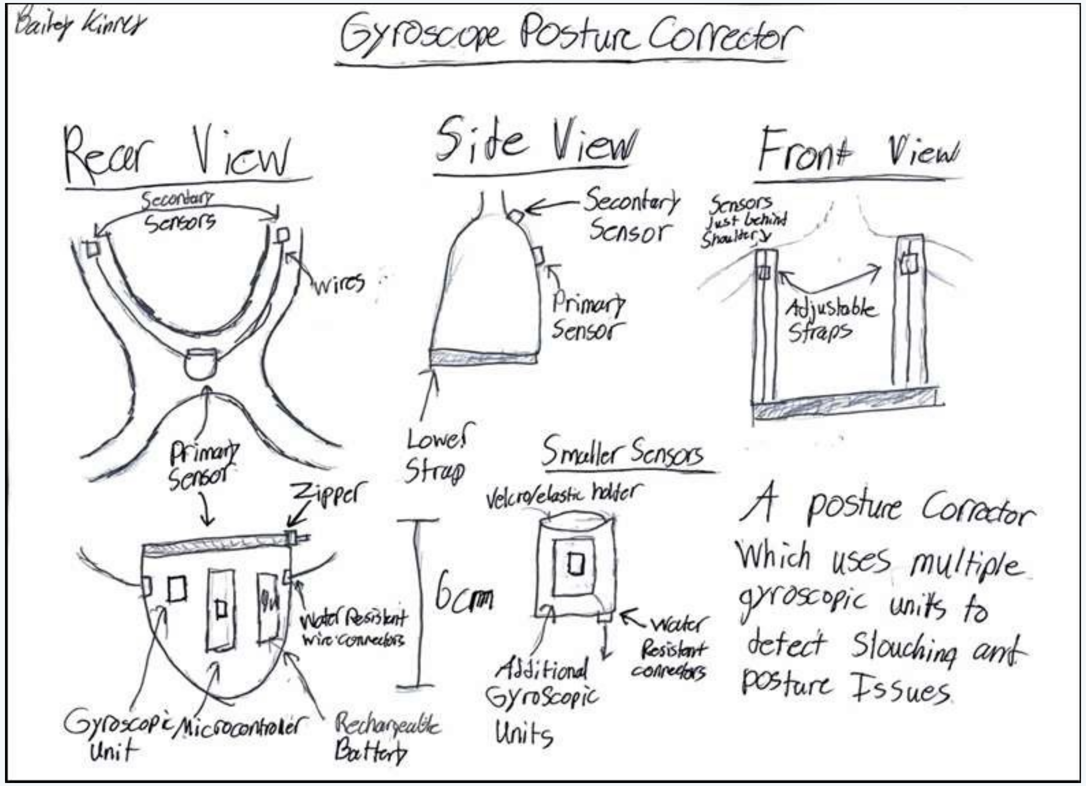
## Design goal

**Detect a posture difference and provide immediate vibration feedback while avoiding alerts during normal bending.**

- Five-person engineering and business team
- Two ADXL345 accelerometers
- Raspberry Pi Pico 2 W
- MicroPython control and filtering
- Wearable back-brace prototype

# My concept focused on relative body-segment motion

The Gyroscope Posture Corrector proposed sensors at different locations on the wearable brace.




## My contribution

- Created the Gyroscope Posture Corrector sketch
- Contributed to overall brainstorming
- Applied biomechanics reasoning to sensor placement and test positions
- Later became the primary programmer and hardware integrator

*The product-render image was a concept preview, not my SolidWorks work.*

# Two sensors created one relative posture measure

One accelerometer was mounted on the upper back and one on the lower back.


**Decision variable: absolute difference between upper- and lower-back angles, with additional bent-over handling.**

# My MicroPython program handled noise and movement context

I was the primary developer of the approximately 200-line program.

### Angle comparison
Upper vs. lower back

### Bent-over handling
Prevent normal bending alerts

### Median-3 filter
Reject short spikes

### Outlier rejection
Ignore implausible samples

### IIR low-pass filter
Smooth rapid variation

### Vibration control
Apply the alert rule

**Build ownership: sensor setup, wiring, nearly all soldering, assembly support, software implementation, and testing.**

# Testing demonstrated feasibility, not validated accuracy

The informal “90%” observation was useful during development, but it was not a controlled performance metric.

## What worked

- Two-sensor comparison detected posture changes
- Filtering improved signal behavior
- Vibration feedback operated in the wearable
- Bent-over handling addressed a known false-trigger case

## What remained

- Sensor placement was not fully optimized
- Connections and mounting needed more reliability
- No formal participant or trial protocol
- More development time was required for product-level behavior

**Next iteration: improve sensor placement and reliability before making an accuracy claim.**

# What the projects demonstrate

The systems were different, but the engineering habits were consistent.

| | |
|---|---|
| **Translate a broad problem into measurable behavior** | Bridge placement, target retrieval, angle difference, vibration output |
| **Use iteration to address concrete failure modes** | Rescue-arm geometry, navigation errors, sensor noise, connection reliability |
| **Work across disciplines** | CAD, electronics, Python, MicroPython, sensors, documentation, presentation |
| **Separate observed performance from validated performance** | Competition times are measured; informal posture testing is not formal accuracy |

# Skills demonstrated in these projects

The emphasis is applied use, not just software familiarity.

## Mechanical

- SolidWorks CAD
- Mechanism design
- 3D-printed parts
- Laser-cut assemblies

## Embedded

- Raspberry Pi Pico 2 W
- ADXL345 accelerometers
- IR distance sensors
- I2C and vibration output

## Software

- Python and MicroPython
- Filtering
- State and condition logic
- Failsafes and calibration

## Engineering

- Concept screening
- Testing and iteration
- Technical documentation
- Judge-facing presentation

THANK YOU FOR REVIEWING

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