An automated, continuous counting inventory module for medication

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PharmAccount
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Mission Statement

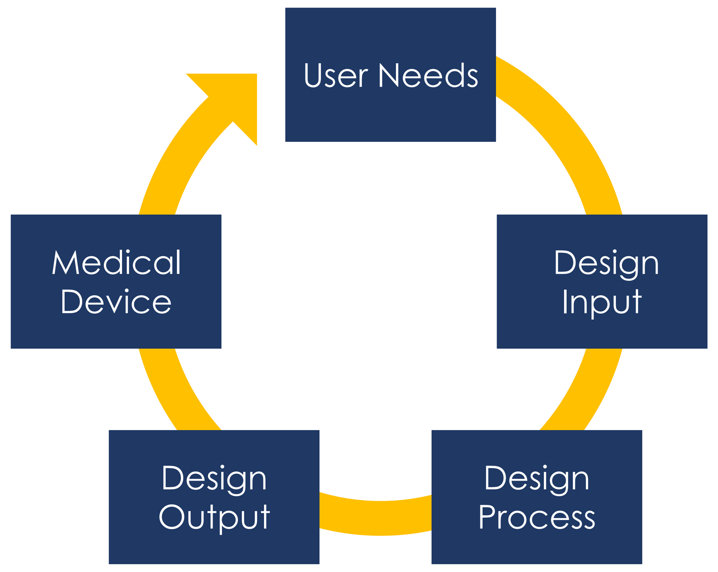
To develop innovative solutions that address drug divergence, enhance security, and improve medication management accountability–ensuring safer practices, better patient outcomes, and streamlined healthcare processes.

Introduction/Background

- Medication reconciled weekly to find discrepancies from human error/drug diversion
- Manual count performed by two RNs
  - Time-consuming
  - Diverts attention from patient care
  - Contributes to provider fatigue
  - Human error → unnecessary investigations

- **This project aims to tackle the limitations of current counting processes by implementing an automated, continuous solution.**

Project Planning



Gantt Chart:

Design Inputs

Customer Need	Metric
Performance	
Comprehensive drug identification	Inventory of total identifiable drugs
Speed	Time it takes for the device to count
Ease of Use	
Ease to restock, remove, and count	Pharmacist & nurse feedback
Ease of implementation	Manufacturing/scaling feedback
Cost	
Affordable cost	Cost to produce
Reduce financial burden from medication loss	Financial setbacks towards drug diversion
Safety	
Patient safety	Patient & nurse feedback
Reliable	
Accurate and precise count	Monitoring system/pharmacist feedback
Service life	Registered nurse feedback

Device Concept and Design

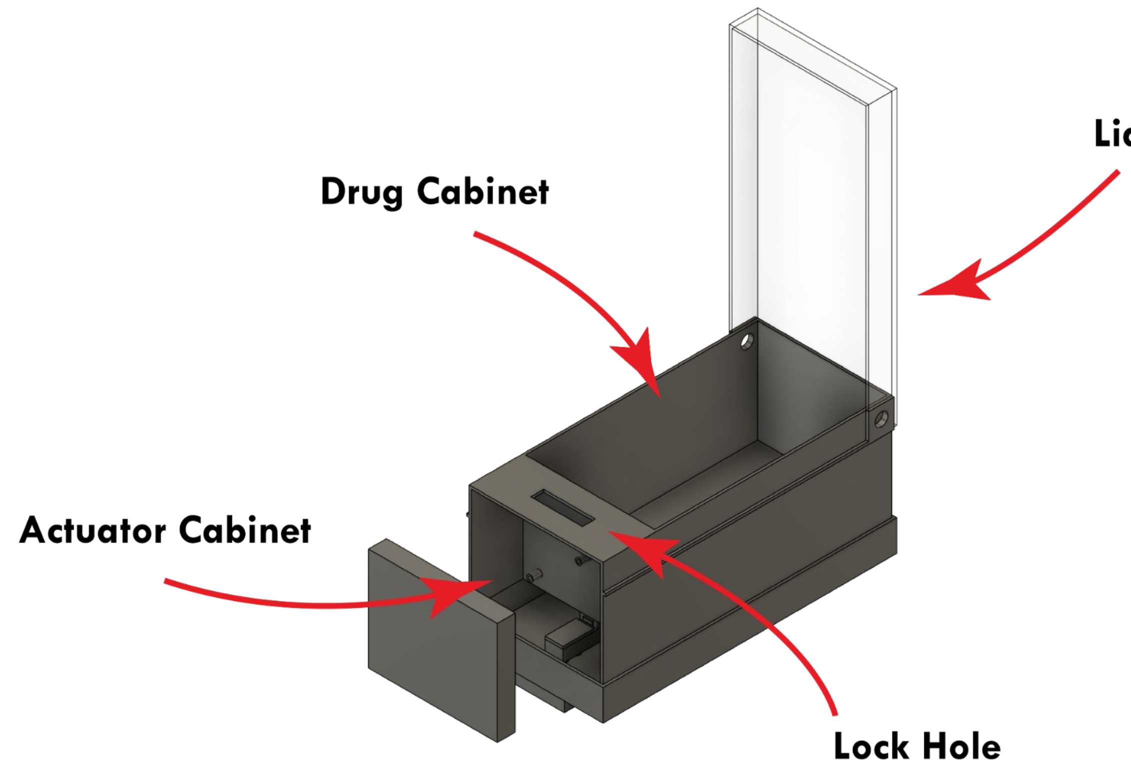


Figure 1: Labeled Fusion model of opened drug cabinet and actuator cabinet.

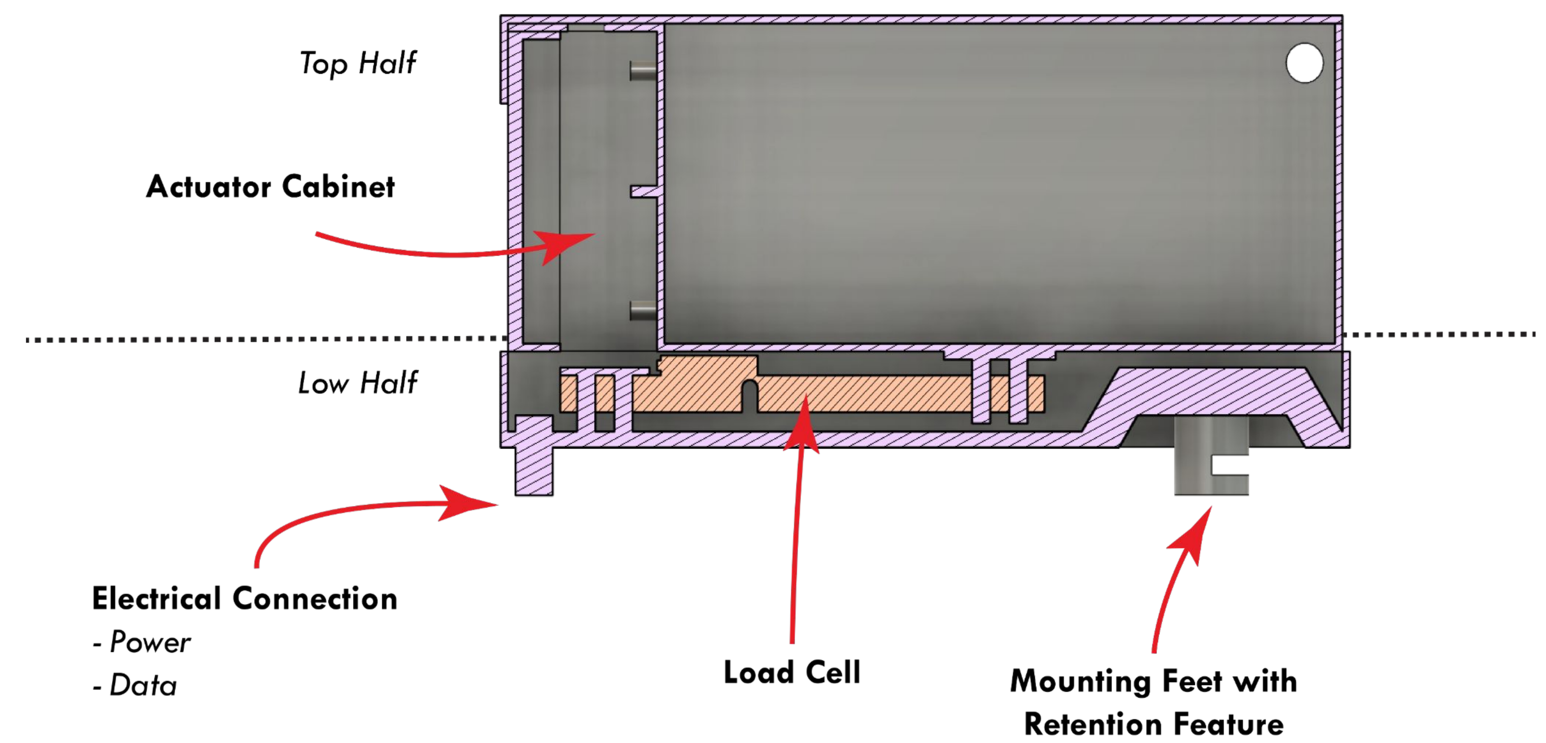


Figure 2: Labeled sagittal Fusion model of cabinet.

Product Architecture

Technical model of how signal voltage of load cell translates to weight

$$G = (U_{sig}/U_{ref}) * (L_{R.C.}/L_{R.O})$$

G = estimated weight (kg)
U_{sig} = signal voltage of load cell (mV)
U_{ref} = reference voltage from the load cell (V)
$L_{R.C}$ = rated capacity of load cell (maximum allowable weight) (kg)
$L_{R.O}$ = rated output of the load cell (1 mV/V)

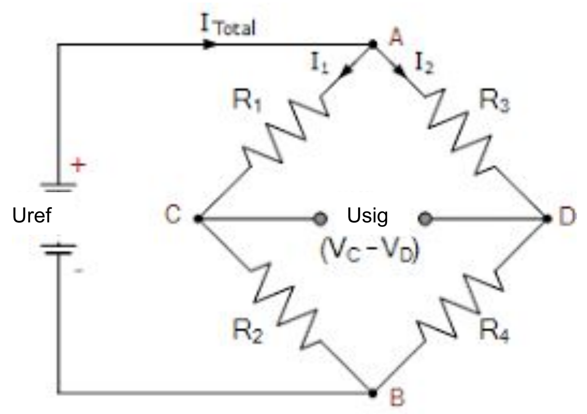
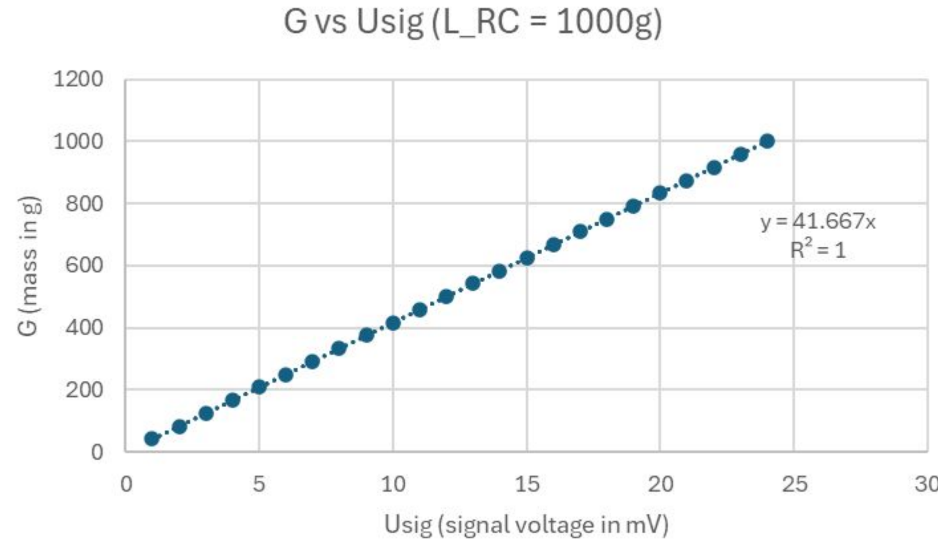
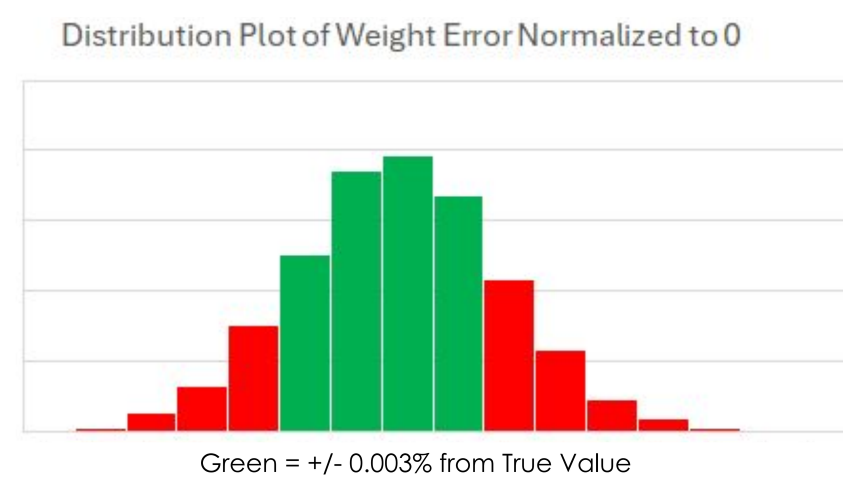


Figure 3: Wheatstone Circuit - measures the electrical resistance between two nodes of a bridge circuit → provide signal voltage





Product Architecture (cont.)

$$I = \sqrt{\frac{mL\pi r^2 + \pi^2 r^4 hpc(T_{transition\ temp} - T_{ambient})}{tph}}$$

I = current (A)
m = mass (kg)
L = latent heat constant (J/kg)
r = radius (m)
h = length (m)
p = resistivity (ohm * meter)
rho = density (kg/m^3)
c = specific heat capacity (J / kg * K)
T = temperature (K)
t = time (s)

Diagram:

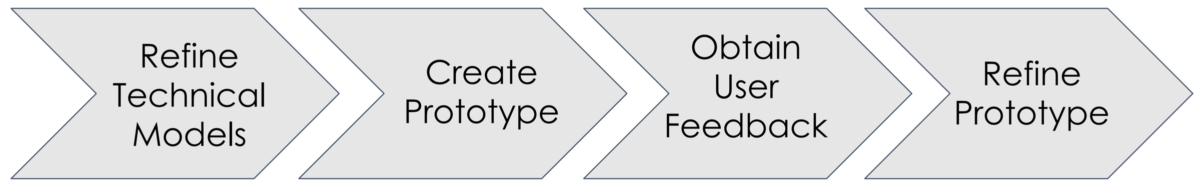
Design for Manufacturing

Component	Material	Purpose	Approximate Cost
Cabinet lid	Clear polycarbonate plastic	—	$5.94 per square foot
Cabinet body	PLA filament	—	—
Load Cell	—	Measure force through voltage → mass	$298
Actuators	Nitinol	Lock and unlock cabinet	$37.95
24-bit ADC	—	Convert analog to digital	$9.95
Microcontroller	—	Regulate current applied to actuators	$10.32

Final Product Specifications

Target Specifications	Target Value
Response Time	10 seconds
Service Life	7 years
Power Voltage	24 V DC
Production Cost	$15 - $20
Count time	18 seconds
Ejection Mechanism	2 seconds
Internal Temperature	10 C below SMA
Storage Capacity	173 cm³
Variable Form Factors	Minimum 3 options
User Interface	Contrast ratio 4.5:1

Design Status and Future Work



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