GROUP 22

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THE BOX WASN'T THE IDEA. THE PROBLEM WAS.

.....arriving at the need before the solution.

THE PROBLEM

- **25–30% of Cash-on-Delivery (COD)** orders are not successfully delivered and are returned to origin (RTO)
- Apartment residents experience **theft at 2x** the rate of homeowners
- Most common package **drop-off locations are insecure**: open areas, lobbies, guard rooms.
- A busy courier in a dense urban area can typically complete **3 to 4 deliveries per hour**

SO WE ASKED WHY?

Why does the courier feel rushed and unsupported?

How do recipients know their parcel is safe?

When a package disappears, who's held accountable?

Why can't delivery happen securely without human presence?

- We interviewed 10+ delivery agents, talked to hostel guards, and households in which everyone goes to work.
- We mapped user journeys. We found frustration, uncertainty, and a huge trust gap in last-mile delivery.

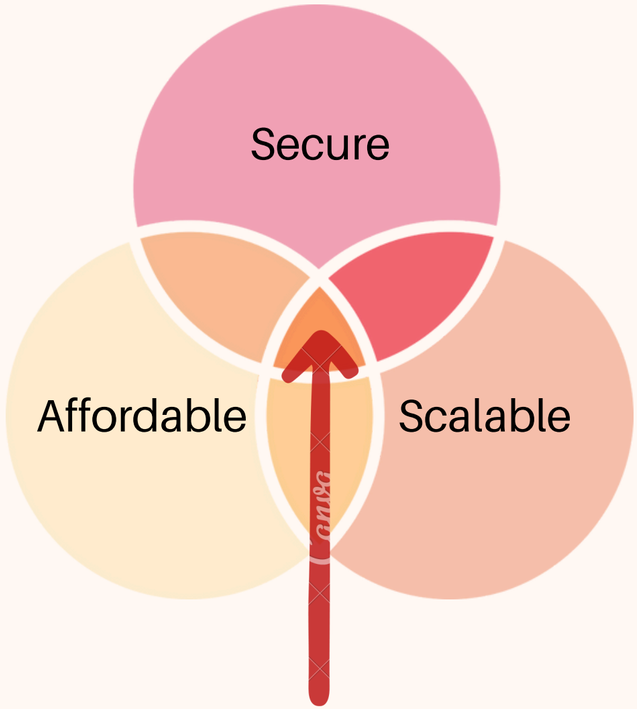
FRAMING THE REAL CHALLENGE

...what are we really trying to solve?

How might we design a secure, user-friendly smart parcel box that enables couriers to safely deliver packages — even when the recipient isn't available — without delays, theft, or dependency on human oversight?

PROBLEMS WITH EXISTING SOLUTIONS

- Bulky, Rigid Design
- Too Expensive
- Weak Security as flaps can be pulled; shared PINs reused
- Complex steps—slows down fast delivery
- No Personalization: One box, shared access — no user-specific security



IDEAL SOLUTION

SOLVING THOSE PROBLEMS

- Anti-theft mechanisms
- Controlled, verifiable access
- Eliminate reliance on guards or public spaces

- Modular compartments
- Multi-user, multi-code system
- Low cost, low power, low maintenance

- Fast drop-off (QR scan)
- No recipient required during delivery
- Simple app/UX

OUR IDEATION WALL

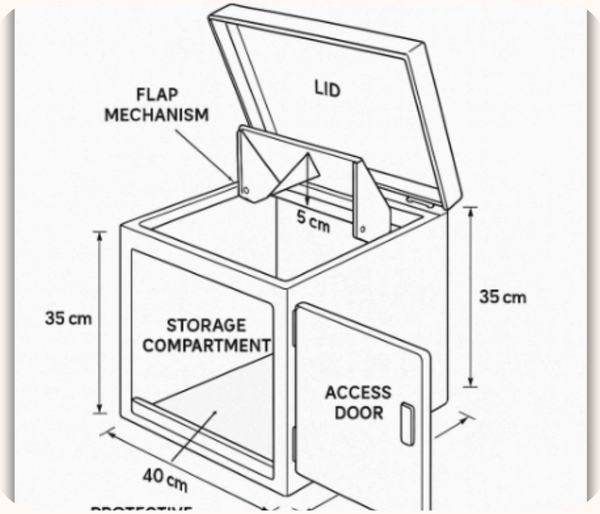
.....explored everything — then let empathy lead the way

💡 Idea 1: Gravity-Drop Inward Folding Flap

MECHANISM:
Steel flaps that fold in under parcel weight but resist upward fishing attempts.

Rejected because:

- Not suitable for fragile items
- Fixed size limits flexibility
- No multi-package management

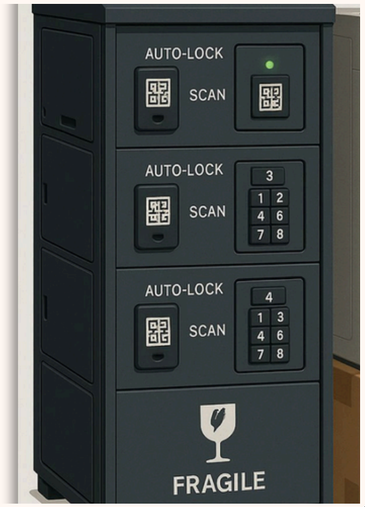


💡 Idea 2: Internal Smart Compartments

MECHANISM:
Each parcel assigned to a locked sub-compartment (via OTP/QR).

Rejected because:

- Requires lots of internal space
- Costly, bulky electronics
- Less scalable for home use



💡 Idea 3: Tray Stack with Vertical Sliding Mechanism

MECHANISM:
Vertical space is optimized with side-wall scissor lifts that adjust tray height based on parcel size and availability.

Rejected because:

- All trays stay accessible
- No privacy, new courier can see older parcels

MEET SECURITIBOX

from Chaos to Concept....

Built with Real-World Mechanics,Powered by Embedded Precision

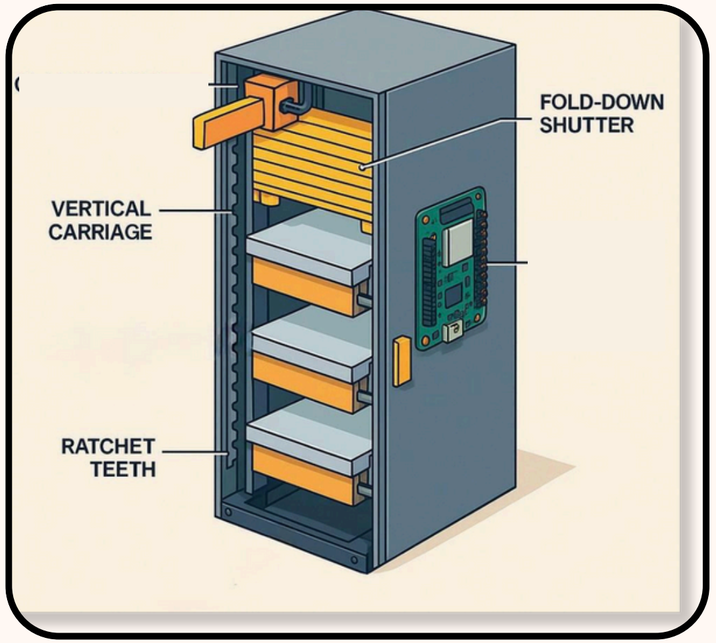
DELIVERY STEPS

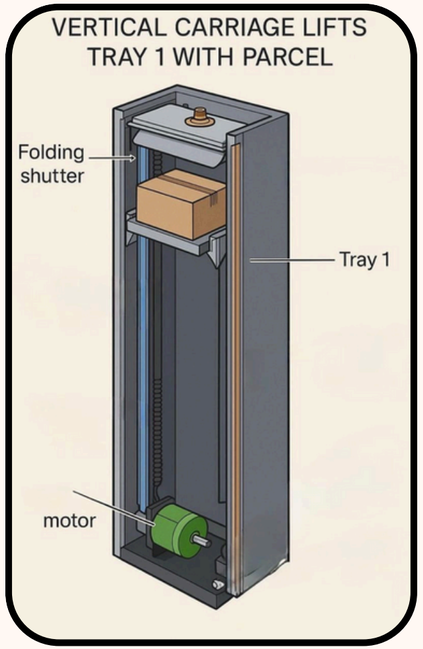
- Scan QR Code
- Enter Parcel Info
- Tray Assigned
- Align Carriage with Tray
- Tray Lifted
- Ratchet Lock Engaged
- Manual Shutter Closed
- Status Confirmed

How **SecuriTIBox** stands out?

- **Automated tray lifting adapts to parcel size — space optimized.**
- **Dual-layer security with mechanical tray lock & smart shutter unlock.**
- **App-integrated delivery & pickup — every action logged.**
- **Low-power + backup battery — reliable even during outages.**

Visual Representation of SECURITIBOX





HOW WE ENGINEERED IT

...moving along one step at a time

Mechanical System

FIXED COMPARTMENTS

↓

TRAY SYSTEM: INDIVIDUAL MOTORS

↓

1 MOTOR+ CLAMP OPTIMIZATION

↓

SEPARATE SHUTTER (SECURITY ADVANTAGE)

Security System

FACE RECOGNITION

↓

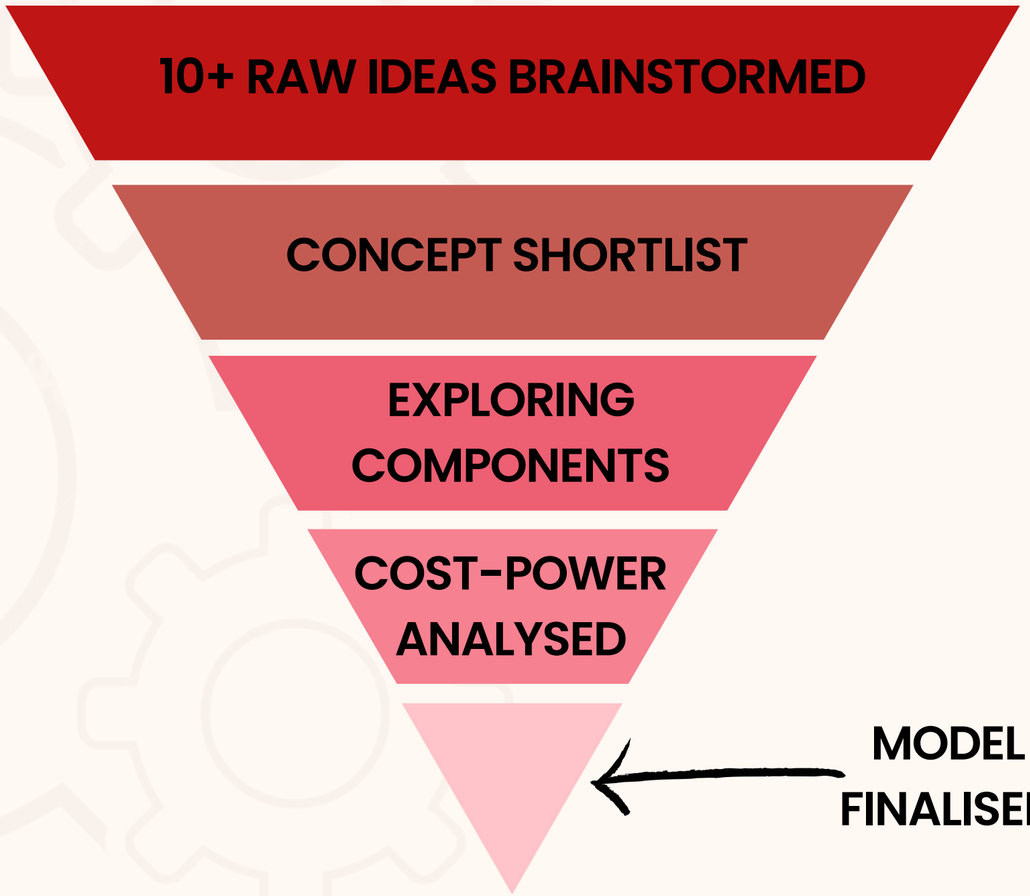
VOICE RECOGNITION

↓

NFC APP PAIRING

↓

BISTABLE SOLENOIDS



AUTHENTICATION WORKFLOW

Courier Delivery Flow

Courier scans QR code → Leads to a web app → Tracking ID + OTP entered → MCU verifies OTP match with backend → Box unlocks

User Retrieval Flow

User gets notification with code → Pickup OTP is entered → Correct tray unlocks → Parcel retrieved → Compartments status updated

Exchange/ Return Flow

Courier scans same QR → Leads to a web app → Enters Tracking ID + Return OTP → Only assigned tray unlocks → Pickup or drop+pickup operation logged

OPERATIONAL FLOW

Inside the SecuriTIBox...

ESP32 receives tray assignment from App/Server

Parcel detected, shutter closes and lock is engaged

Stepper Motor activates → moves carriage to the tray

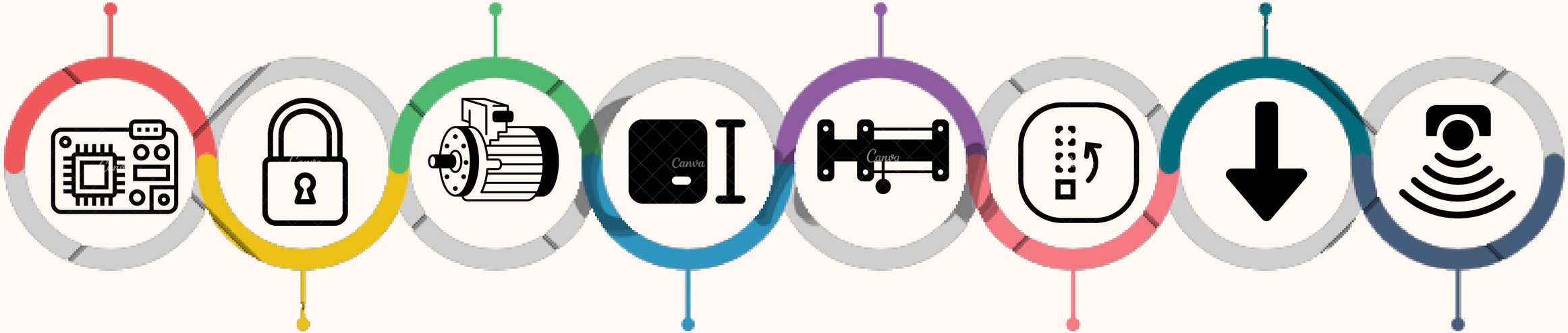
Parcel height is detected.

The trays latches with the carriage.

Carriage lifts tray upwards to target height.

Carriage lowers slightly to disengage from tray

IR Transmitter-Receiver on carriage
→ Detects existing parcel during downward motion
→ Beam interruption = tray surface detected



THE BOX WITHIN

...the building blocks

Control & Intelligence

CC3235MODSF: Acts as the central processor of the system. It handles all control logic

DRV8873, DRV8825: Allows safe and efficient control of bidirectional current to solenoid locks and stepper motor

TPS2595 Power Switch : Digitally controlled switch which helps to route the driver's outputs to the required compartment.

Motion & Actuation

NEMA17 Geared Stepper Motor: Provides high-torque, precise motion for moving the vertical tray via belt-drive mechanism.

MG996R Servo Motor: Allows the trays to come back to original position.

Push-Pull Solenoid (5V) : Used for latching the tray to the carriage

TLX Bistable Solenoid : Latching solenoid that doesn't need continuous power. Used for locking the shutter of each parcel.

Power & Sensing

12V SLA Battery (4.5Ah) : A sealed lead-acid rechargeable battery that supplies stable power. Used as backup.

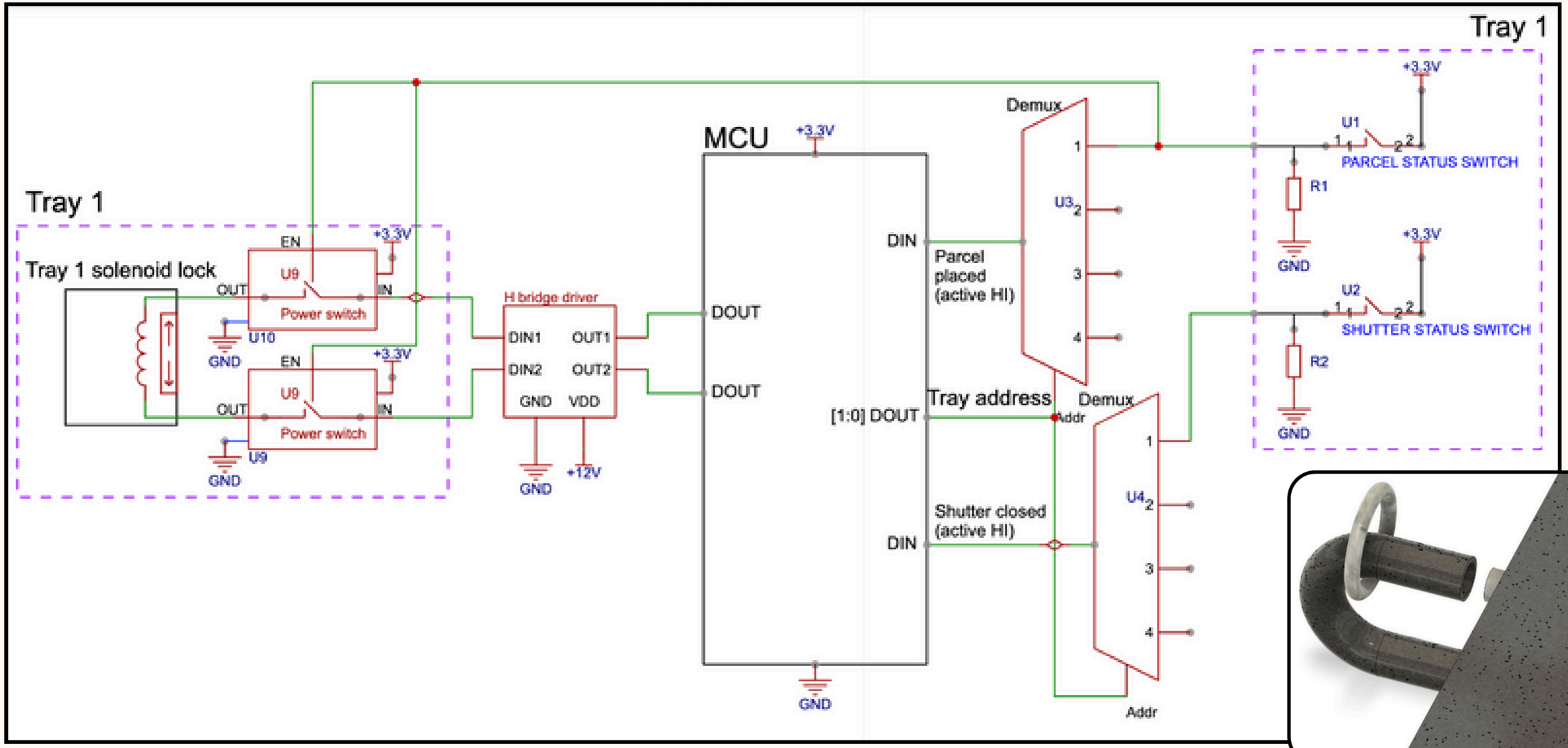
IR Transmitter-Receiver: Senses the presence of a parcel.

KW11 Micro Limit Switch : A mechanical feedback switch used to detect whether lock has successfully engaged.

Belt-Driven Actuator : Converts rotary motion from the stepper motor into linear movement to shift carriage.

HOW IT ALL CONNECTS

...the invisible threads



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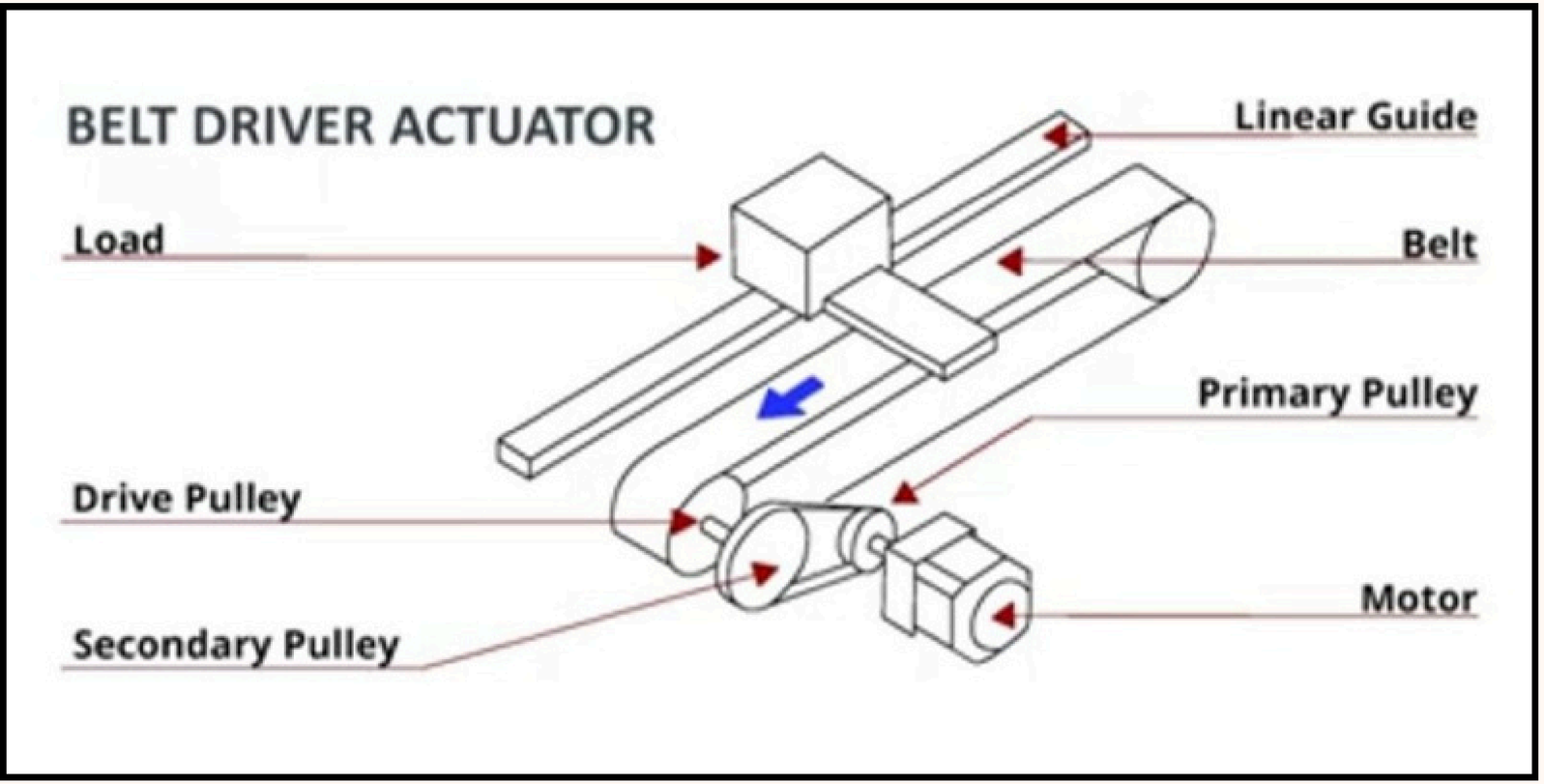
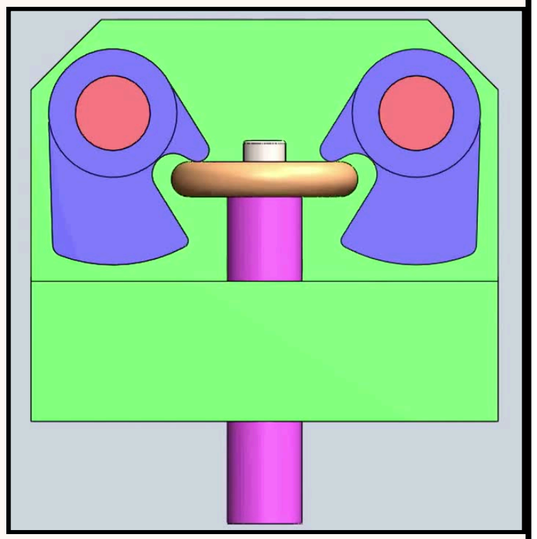
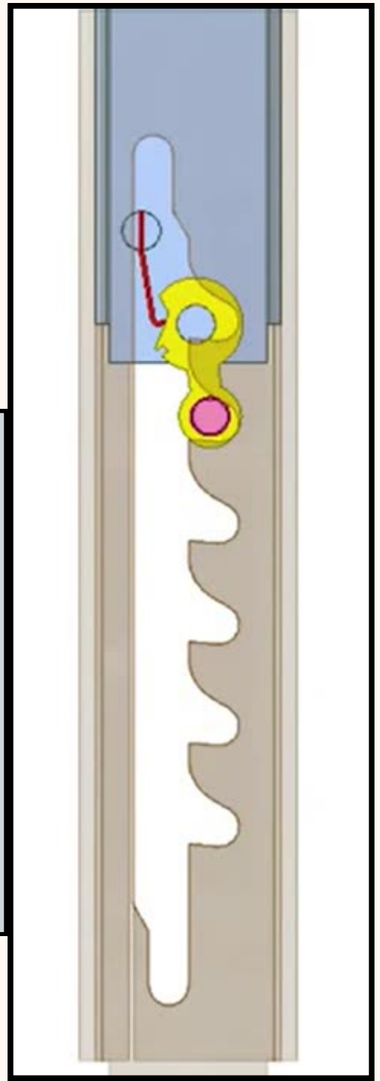


Linear Ratchet Anchoring Mechanism

Pin-hole latching mechanism





Links for the videos: https://www.youtube.com/watch?v=mmi2QNHwpMY
https://www.youtube.com/watch?v=1PzEya9mjLY

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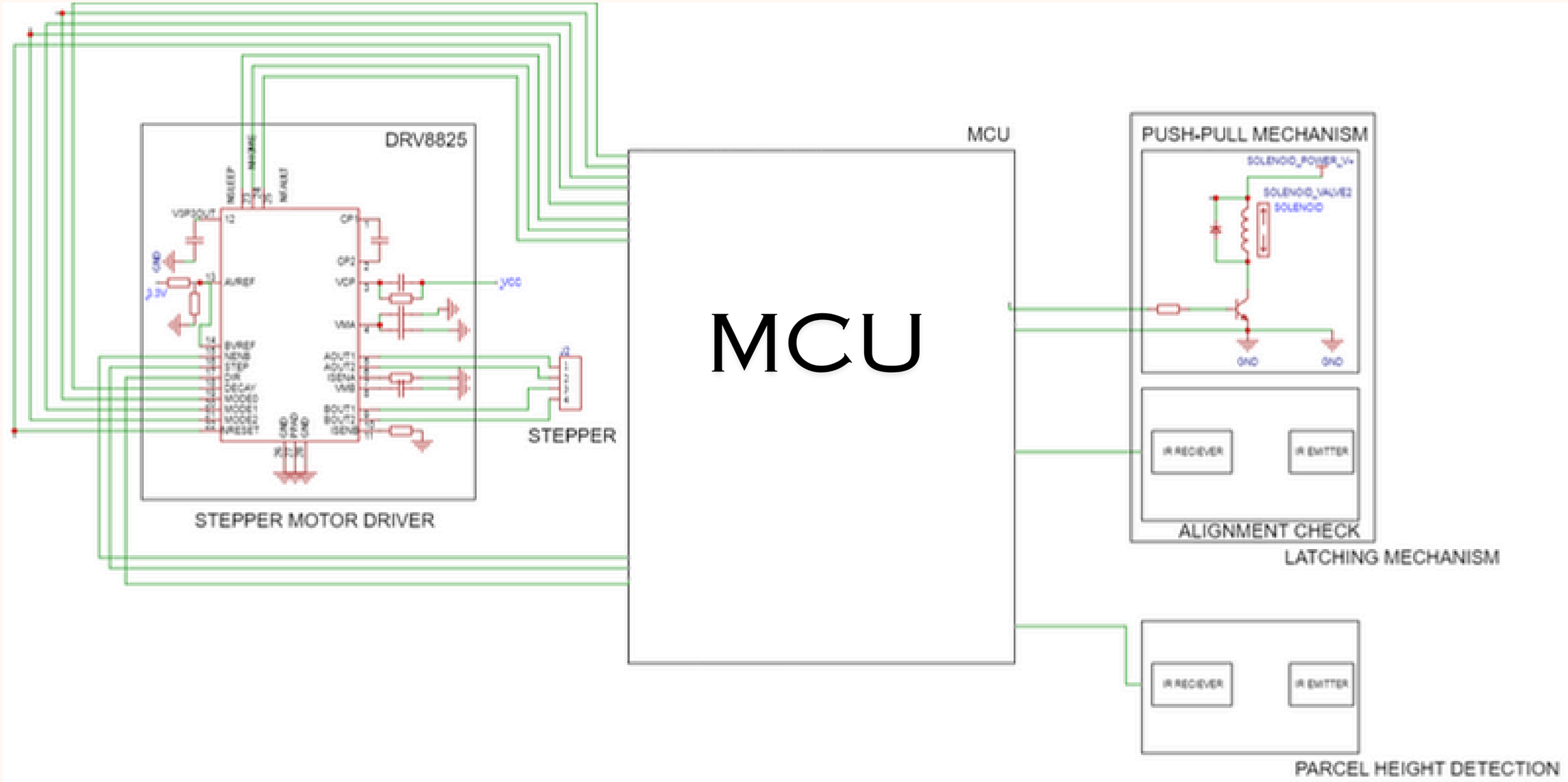
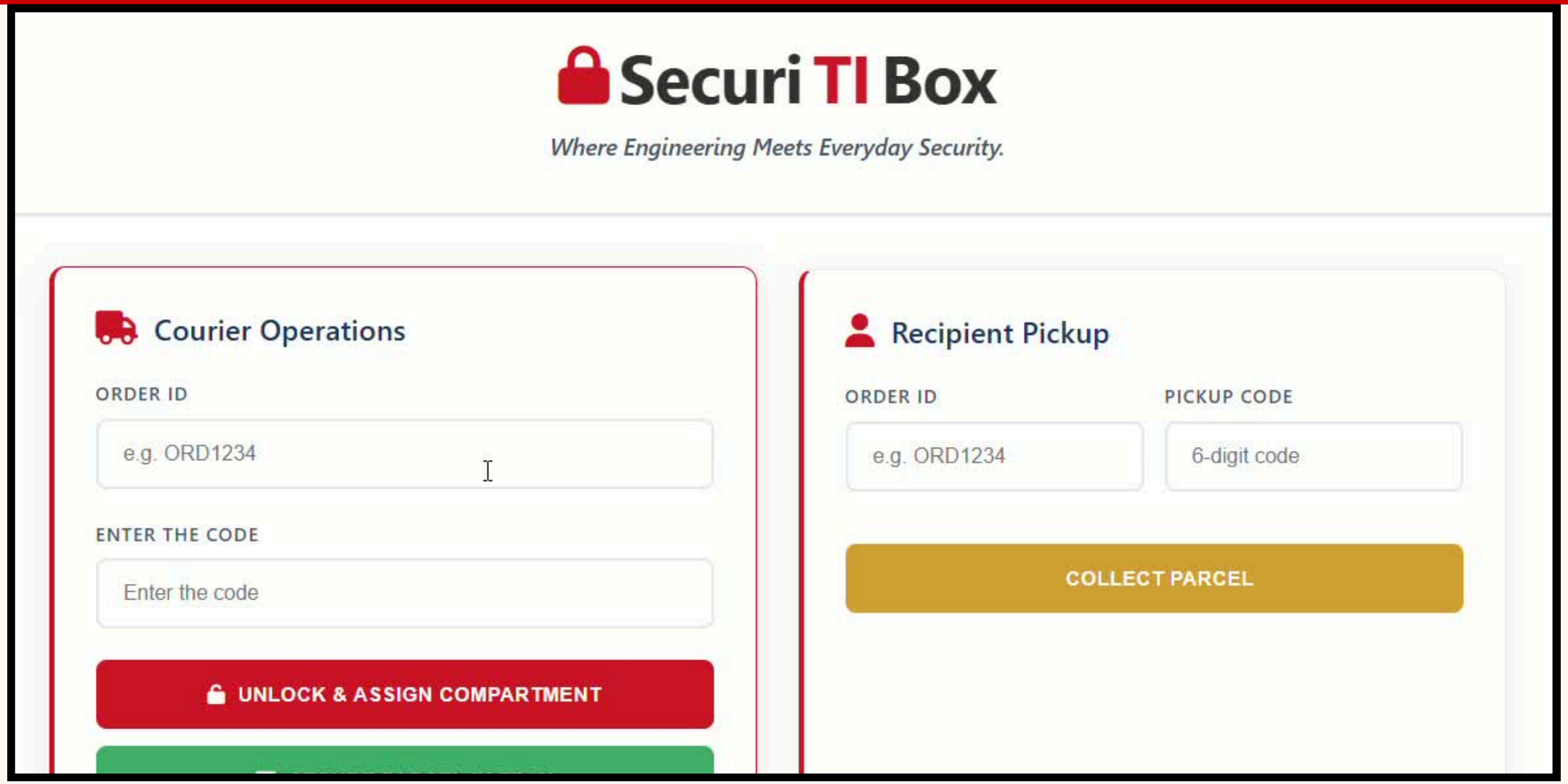


SMART MOVES: SIMULATED

...system logic in action

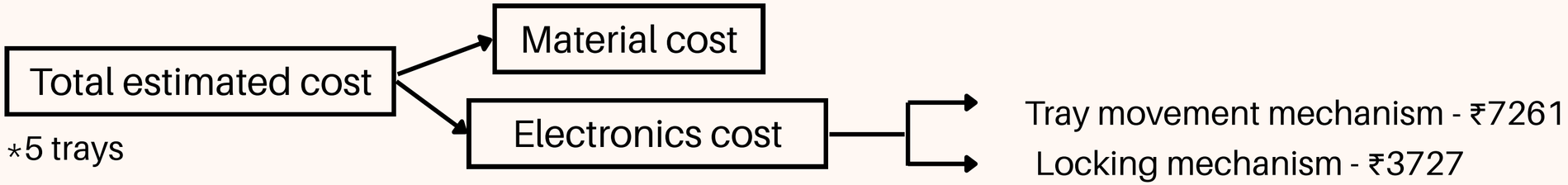


Link for the video: https://drive.google.com/file/d/12R2IDLaYPEy_BIYM2NcUldS34lstOl9p/view?usp=sharing

SIZE & SPEND

...space, steel & savings

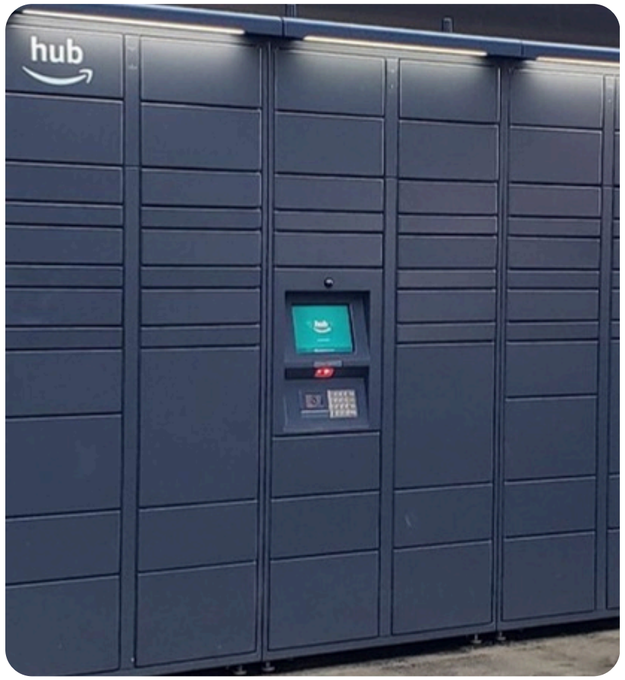
Component	Dimensions (mm)	Material & Thickness	Weight	Unit Cost	Total (INR)
Outer Wall	430 × 410 × 1100	Galvanized Steel, 10mm	85 kg	₹63/kg	₹5,350
Tray (5 pcs)	416 × 396 × [height]	Aluminum, 5mm	11 kg (total)	₹220/kg	₹2,420
Shutter (5 pcs)	420 × 730	Aluminum, 1mm	0.82 kg/shutter	₹220/kg	₹910
Total					**₹8,680**



SECURITIBOX VISION

FUTURE SCOPE

- Amazon Hub-Style shared system with tray assignment
- Scalable tray assignment (2-6 trays), face scan, cloud access



MARKETING STRATEGY

- Target: Working Couples, elderly people, Logistics Firms
- Channels: Amazon, social media, smart home bundles

Dimensions and Durability

- Dimensions: 430 × 410 × 1100 mm (W × D × H)
- Weatherproof ,Galvanized and rustproof .

COMPETITIVE EDGE

- Height based tray allignment & web unlock
- Outperforms basic lockers with automation

MAINTENANCE

- Low maintenance
- Occasional cleaning and lubrication

Installation & Deployment

- Wall-mounted or standalone
- Anchoring kit included

ENVIROMENTAL IMPACT

- Reduces failed delivery emissions
- Long-term reusability

FOOTNOTES OF INNOVATION

...where we drew from

- TI documentation:
  - Solenoid drivers
  - IoT Microcontrollers
  - Bi-directional power switches
- Youtube tutorials on the interfacing of different peripherals (motor drivers, sensors)
- Electronics stack exchange
- Datasheets of components
  - https://mm.digikey.com/Volume0/opasdata/d220001/medias/docus/6649/Series%20SS%20Switches.pdf
  - https://www.ti.com/product/CC3235MODSF
  - https://www.ti.com/lit/ds/symlink/tps2595.pdf?ts=1750322993511
  - https://www.ti.com/lit/ds/symlink/drv8873.pdf?ts=1750317383117&ref_url=https%253A%252F%252Fwww.mouser.kr%252F
  - https://www.ti.com/lit/ds/symlink/drv8825.pdf
  - https://static.tlxtech.com/files/Bidirectional-Latching-Solenoid.pdf?v=1661797325
- Simulation references:
  - https://www.youtube.com/watch?v=mmi2QNHwpMY
  - https://www.youtube.com/watch?v=1PzEya9mjLY

THANKYOU

Questions? We're all ears