Final Problem Statement: Smart Trolley for Autonomous Shopping & Billing

In today's world of automation, shopping experiences still involve long queues at billing counters and manual trolley handling. Imagine a **Smart Trolley** that can make shopping hands-free, queue-free, and intelligent.

Your challenge is to design and develop a **Smart Autonomous Shopping Trolley** with the following requirements:

Core Features

1. Real-time Object Scanning & Billing

- Whenever an item/box is placed inside the trolley, it should be scanned (via **barcode/QR/Computer Vision**) and its price should automatically get added to a **web-based billing system**.
- Example: If you add a ₹5 item, the webpage shows ₹5. Adding another ₹10 item updates the total to ₹15.
- If an item is removed from the trolley, the webpage should update immediately, subtracting that item's cost.
- **Audio Feedback:**
    - On addition → "Item added: ₹X. Total ₹Y."
    - On removal → "Item removed: ₹X. Total ₹Y."
    - On total update → "Please pay ₹Y" (always announcing the **current total price**).

2. Dynamic Webpage & Payment Gateway Simulation

The webpage must display:

- List of items added.
- Total price in real time.
- Once the customer decides to checkout, a **payment QR scanner** should be generated on the webpage where they can simulate paying.
- **Audio Feedback for Checkout:**

    - On checkout start → "Checkout started. Scan the payment QR."
    - On successful payment → "Payment received. Thank you!"

3. Human Following Capability

- The trolley should **autonomously follow the user** while they shop.
- It should track **left/right movements** and maintain a safe following distance.
- If the user is closer than **10 cm**, the trolley must **stop automatically** to allow safe adding/removing of items.
- **Audio Feedback:**
    - "Follow mode on." / "Stopping for safety."

Hardware & Platform Rules

- **Laptop Users:** Can use laptop microprocessor/camera for Computer Vision & scanning.
- **Raspberry Pi Users:** Must implement everything (scanning, vision, and web server) on **Pi itself** (no laptop processing allowed).
- **ESP32 Users:** Must integrate server and IoT functionality to handle billing and live updates.

Expected Output

A fully working prototype of the Smart Trolley that demonstrates:

1. **Autonomous human-following** with proximity stop + audio.
2. **Live item scanning & billing** on webpage with **real-time audio announcements** ("Item added", "Item removed", **"Please pay ₹Y"**).
3. **Checkout simulation** with QR payment gateway + audio confirmation.

Evaluation Criteria – Smart Trolley Hackathon (100 Marks)

1. Object Scanning & Billing (30 Marks)

- (10) Correct detection of item addition via barcode/QR/Computer Vision.
- (10) Correct removal of items with immediate billing update.
- (5) Webpage shows real-time list & prices.
- (5) Accuracy & reliability of billing logic (no false adds/removes).

2. Audio Feedback System (20 Marks)

- (5) Clear audio for item addition (“Item added ₹X. Total ₹Y”).
- (5) Clear audio for item removal (“Item removed ₹X. Total ₹Y”).
- (5) **Correct announcement of current total price** after every update (“Please pay ₹Y”).
- (5) Additional checkout/payment audio (“Checkout started”, “Payment received”).

3. Dynamic Webpage & Checkout (20 Marks)

- (10) Webpage displays items + live total correctly.
- (5) Checkout simulation with QR code generation.
- (5) Payment simulation success/failure reflected on webpage.

4. Human Following & Safety (20 Marks)

- (10) Trolley follows user smoothly (left/right tracking, correct distance).
- (5) Stops automatically when user is within **≤10 cm**.
- (5) Safety + follow mode audio feedback (“Follow mode on”, “Stopping for safety”).

5. Integration, Reliability & User Experience (10 Marks)

- (5) Seamless integration of scanning, billing, webpage, following, and audio without blocking/delays.
- (5) Robustness, ease of use, and polished user experience (volume/mute handling optional but bonus).

✅ **Total = 100 Marks**