TED UNIVERSITY

PRICELINK - Sustainable IoT Ecosystem for Smart Apparel Pricing

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Abstract & Motivation

PriceLink addresses the Technology-Market Gap in Turkish apparel retail. Frequent price adjustments caused by economic volatility lead to extreme labor loss and environmental waste from paper tags.

Our solution provides Miniaturized, Low-Power E-Ink Tags that integrate seamlessly with clothing, ensuring real-time price integrity.

Global & Societal Impact (SDG 12)

Environmental
Zero paper waste. Reusable E-Ink tech eliminates single-use tags.

Economic
Reduces labor overhead by 85% for high-frequency pricing updates.

Societal
Empowering staff to focus on customer service over manual tasks.

Global
Modernizing retail through green digital transformation.

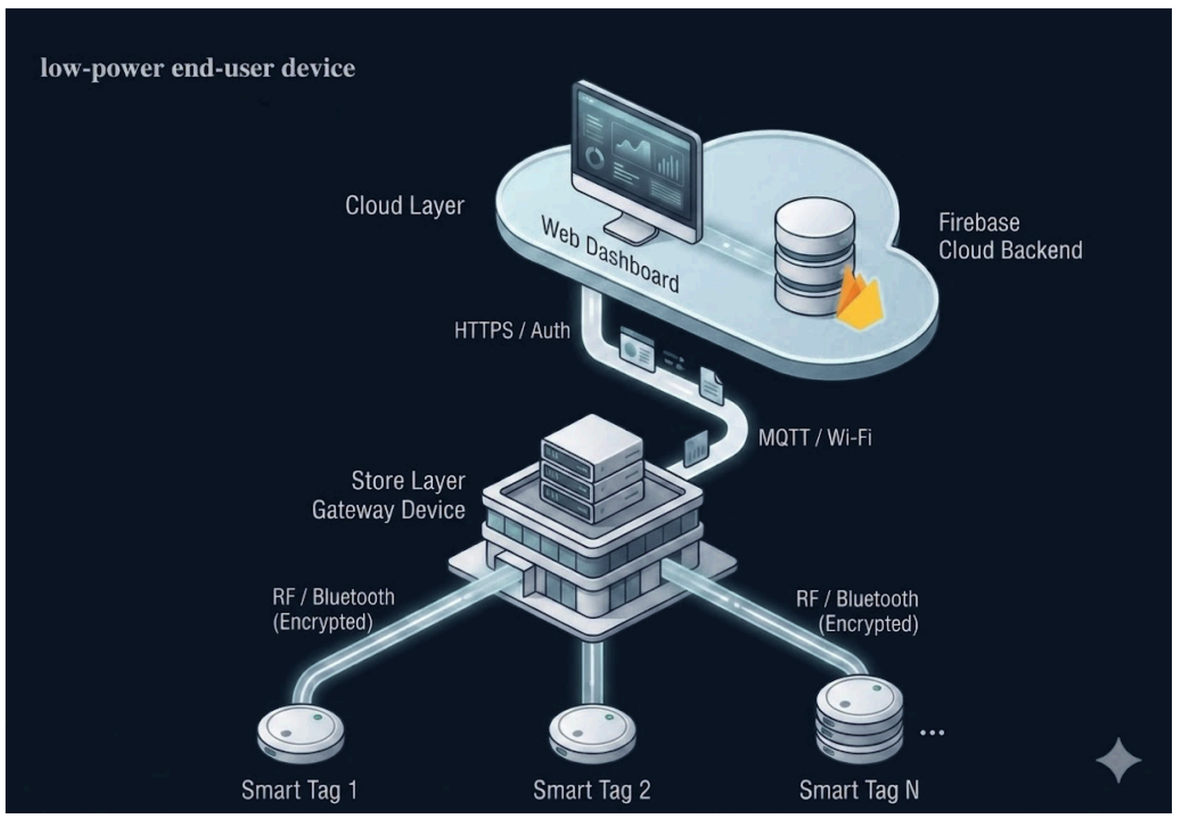
Core Technologies (Tech Stack)

- **Hardware:** ESP32 SoC, GxEPD2 Library, 2.9" E-Ink Display.
- **Communication:** MQTT (Publish/Subscribe), WebSocket, WPA2 Encryption.
- **Software:** Node.js, Mongoose ODM, React.js, Git/GitHub.

Target Performance (KPIs)

- **Latency:** Targeted sub-5 second end-to-end synchronization.
- **Data Integrity:** Bi-directional Handshake (ACK) protocol ensuring 100% pricing accuracy.
- **Persistence:** Fail-safe display visibility during power or network outages due to bistable hardware.

System Architecture



Usage Scenario: Digital Transformation in Retail

1. Traditional Method (The Problem)

- **Trigger:** Market volatility causes a price increase in 500 items.
- **Manual Labor:** Staff spends 6+ hours printing, cutting, and manually replacing paper tags.
- **Errors:** High risk of "Wrong Price at Checkout" complaints due to human error.
- **Waste:** Hundreds of paper and plastic tags are thrown away.

2. PriceLink Method (The Solution)

- **Trigger:** Manager updates prices on the React Admin Panel in seconds.
- **Auto-Sync:** MongoDB updates the records and triggers an MQTT broadcast.
- **Edge Update:** Smart E-Ink Tags update their displays across the store instantly.
- **Result:** 0% Paper Waste, 100% Accuracy, <5 Seconds Sync.

Conclusion

- **Validation:** The system has been rigorously evaluated and successfully aligns with the design goals established for both semesters.
- **Success:** Operational continuity was observed across all layers, proving the viability of this miniaturized IoT ecosystem.