



# System Analysis and Design

## CSE 307 (SEC – 02)

### Summer – 2025

#### Assesment - 2

#### “Group Project”

**Project Name:** A Smart Inventory Management System for Small Businesses Using RFID

#### Group Members

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**Date of Submission:** 13/07/2025

## **A1. Software Development Methodology Selection:**

### **Selected Methodology: Agile Software Development**

#### **Why Agile?**

Agile Software Development is an iterative and collaborative approach that emphasizes flexibility, continuous feedback, and rapid delivery. For a project like “**A Smart Inventory Management System for Small Businesses Using RFID**”, Agile is the most appropriate methodology due to the following key reasons:

#### **Justification – 5 Valid Points Supporting Agile:**

##### **1. Iterative and Incremental Development:**

Agile breaks down the project into small functional units called sprints (usually 1–2 weeks long). In each sprint, a specific set of features is developed and tested.

- For this RFID-based inventory system, different modules (RFID tracking, real-time dashboard, low-stock alerts, reporting) can be developed in separate sprints.
- This ensures progressive improvement while minimizing the risk of building a large, flawed system all at once.

##### **2. Early and Continuous Feedback from Stakeholders:**

Agile encourages constant interaction with end-users and stakeholders.

- Storekeepers, business owners, and system admins can test early versions of the system and provide feedback.
- Their insights on usability, RFID scan issues, or reporting requirements can guide further development, resulting in a system that actually fits real business operations.

##### **3. Flexibility to Changing Requirements:**

Small businesses often have diverse and evolving inventory management needs.

- One business might want POS integration; another may need environmental monitoring (temperature/humidity sensors).
- Agile enables the development team to modify or reprioritize features based on changing business goals or technical constraints—without disrupting the entire system.

##### **4. Risk Management and Early Bug Detection:**

Agile involves continuous integration and frequent testing, ensuring that errors are caught early.

- With hardware-software integration (e.g., RFID readers with Arduino), there's always a risk of connection failures, latency, or data inconsistency.
- Agile's test-driven approach ensures that such problems are discovered and solved before they escalate.

## **5. Promotes Collaboration and Transparency:**

Agile promotes a cross-functional team structure, encouraging close collaboration between developers, hardware engineers, and business users.

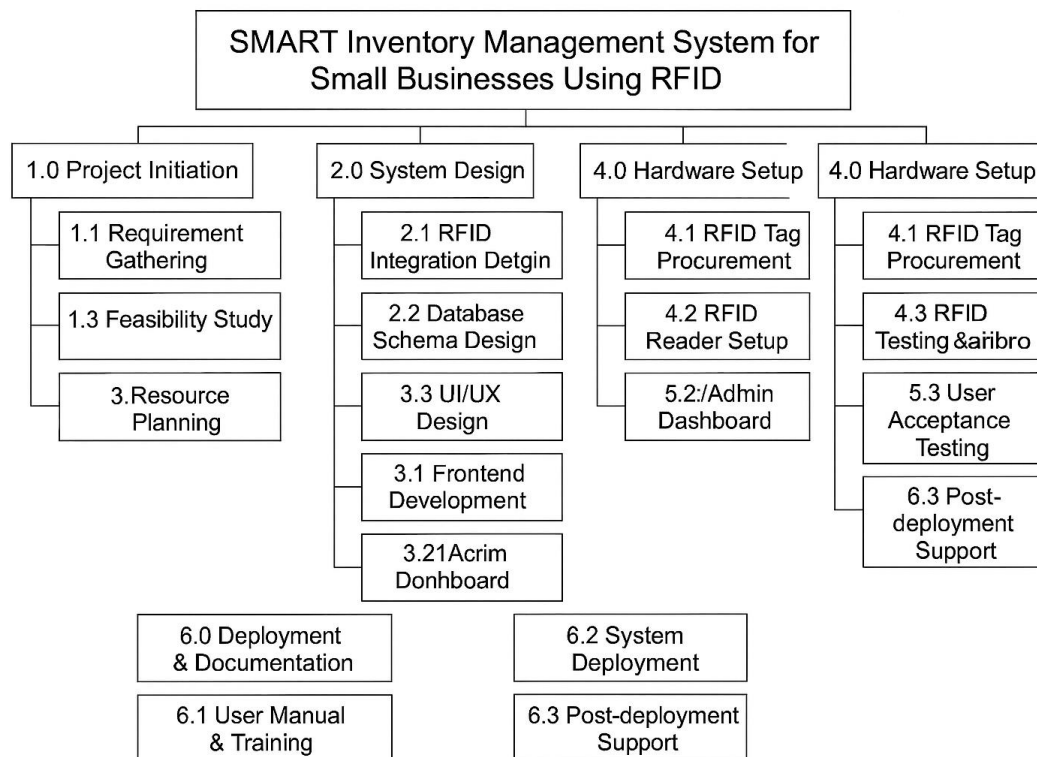
- Daily stand-ups, sprint reviews, and retrospectives ensure everyone stays informed.
- This transparency reduces communication gaps and keeps the team aligned with the core goal: building a practical and scalable inventory solution for small businesses.

## **Conclusion:**

Agile is highly suitable for this project because it:

- Supports real-time stakeholder collaboration.
- Encourages frequent delivery of working software.
- Allows for quick changes based on actual business needs.
- Minimizes risks with early testing.
- Ensures a system that is user-friendly, scalable, and effective.

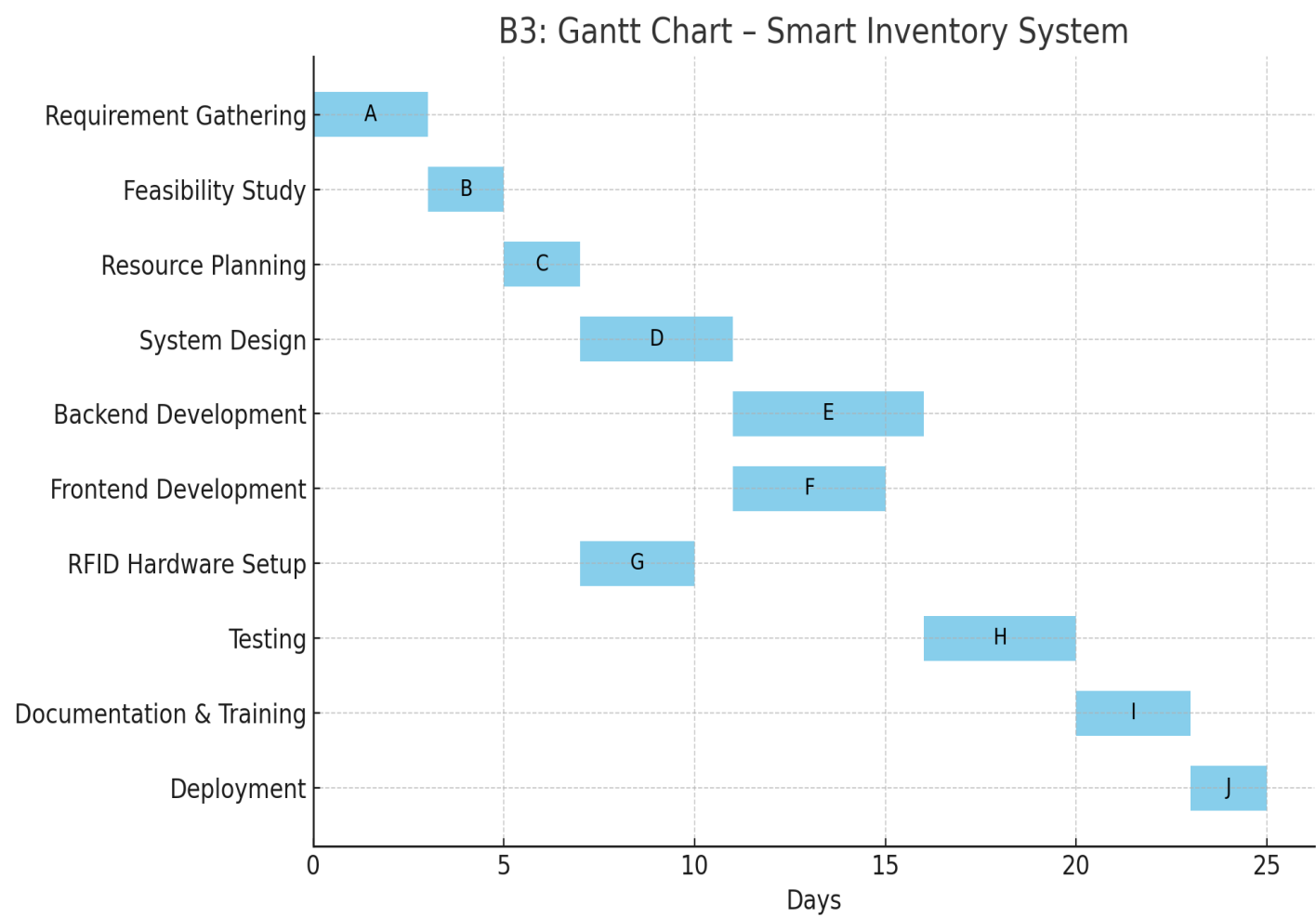
**Deliverables:** Software Modules, Hardware Integration, Documentation, Testing.



## B2. Activity List with Duration, Dependencies, Resources and Cost:

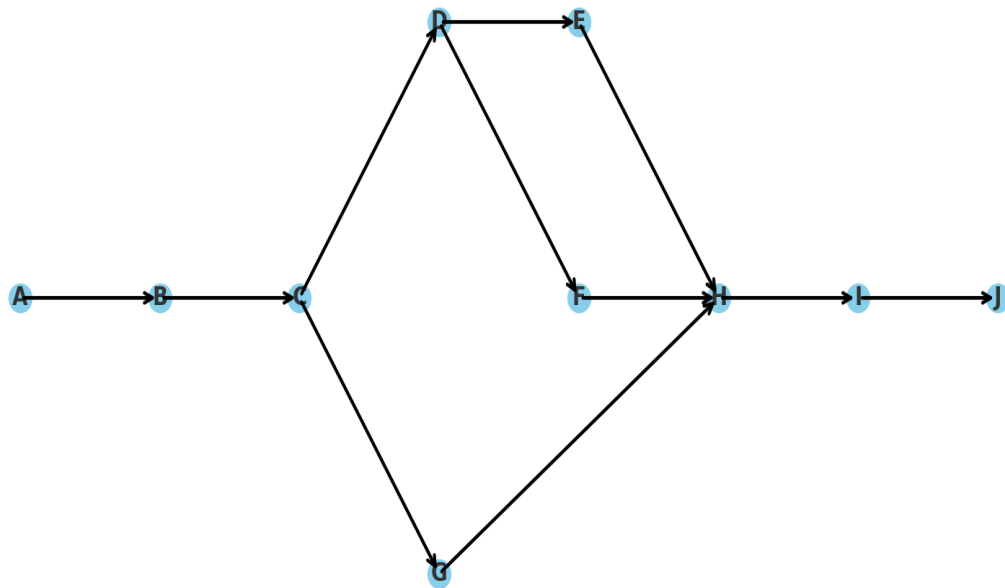
Activity ID	Activity Name	Duration (Days)	Dependency	Resources	Cost (BDT)
A	Requirement Gathering	3	-	BA, PM	6000
B	Feasibility Study	2	A	PM, Developer	4000
C	Resource Planning	2	B	PM	3000
D	System Design	4	C	Developer, Designer	8000
E	Backend Development	5	D	Developer	12000
F	Frontend Development	4	D	Developer, UI Designer	10000
G	RFID Hardware Setup	3	C	Technician, Hardware Vendor	15000
H	Testing	4	E, F, G	QA Engineer	6000
I	Documentation & Training	3	H	PM, Developer	4000
J	Deployment	2	I	PM, Developer	5000

**B3. Gantt Chart (Text Representation):**



#### B4. Network Diagram (Text Representation):

B4: Network Diagram - Smart Inventory System



## **C1. List of Expense Heads:**

### **Initial Costs:**

#### **1. Hardware:**

- RFID Tags:  $\$0.10/\text{unit} \times 5,000 = \$500$  (Paper 1, IEEE 2022)
- RFID Readers:  $3 \times \$300 = \$900$
- Edge Computing Nodes (Raspberry Pi):  $2 \times \$200 = \$400$  (Paper 9)

#### **2. Software:**

- Cloud Subscription:  $\$50/\text{month} \times 12 = \$600/\text{year}$
- RFID Middleware License: \$1,000 (one-time)

#### **3. Implementation**

- Staff Training:  $20 \text{ hours} \times \$15/\text{hour} = \$300$  (Paper 2, IJPE 2021)
- System Integration: \$1,500

### **Recurring Costs:**

#### **4. Maintenance:**

- Tag Replacement (10% annually): \$50/year
- Software Updates: \$200/year

Total 3-Year Cost: \$5,450

## **C2. Possible Benefits:**

#### **1. Operational Savings:**

- 90% reduction in inventory errors → \$3,000/year in labor savings (Paper 1)
- 22% fewer stockouts → \$2,500/year in recovered sales (Paper 2)

#### **2. Theft Prevention:**

- 93% reduction in shrinkage → \$1,800/year

#### **3. Productivity Gains:**

- 30% faster inventory counts → 40 staff hours/month saved

Total 3-Year Benefits: \$22,200

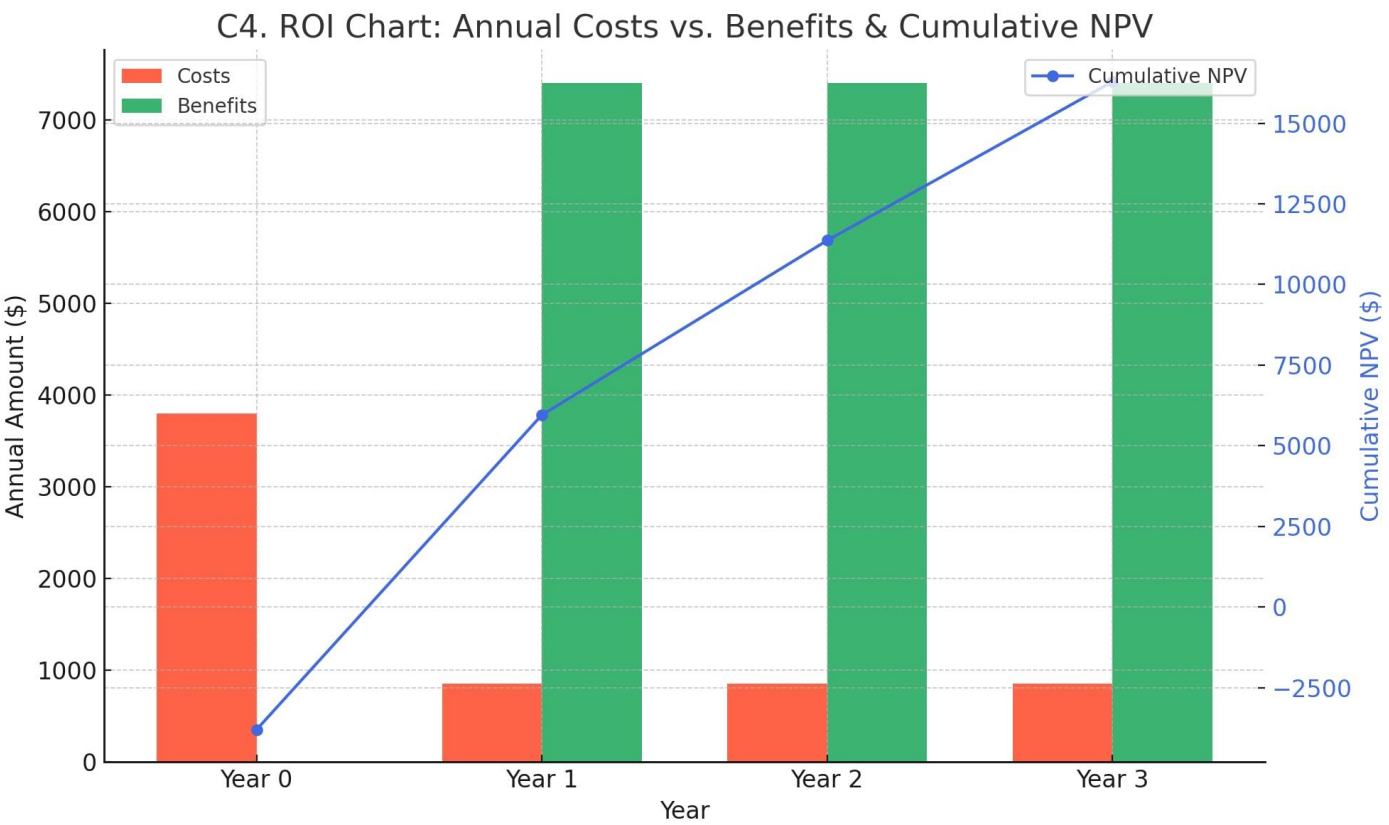


C3. Net Present Value (NPV) Table):

NPV = \$12,485 (Highly feasible)

Year	Costs (\$)	Benefits (\$)	Net Cash Flow (\$)	Discount Factor (10%)	Present Value (\$)
0	3,800	0	-3,800	1.000	-3,800
1	850	7,400	6,550	0.909	5,955
2	850	7,400	6,550	0.826	5,410
3	850	7,400	6,550	0.751	4,920
Total	6,350	22,200	15,850		12,485

C4. Return on Investment (ROI) Chart:



## **D1. Identify the suitable method of requirement discovery with justification:**

The most suitable methods of requirement discovery is – Interviews with Small Business Owner and Staff. Along with that, there can be other useful methods like Observation of current inventory processes, Questionnaires/Surveys, Document Analysis and Prototyping with feedback

### **Interviews with Small Business Owners and Staff:**

To understand their current inventory management practices, pain points, and expectations from an RFID-based system. Interviews enable capturing detailed qualitative insights regarding workflows and challenges they face.

Some other useful methods:

#### **1. Observation of Current Processes:**

By observing current inventory handling, storage practices, and audit procedures, we can identify bottlenecks, manual errors, and inefficiencies that the RFID system should address.

#### **2. Questionnaires/Surveys:**

Distributing structured questionnaires to multiple small businesses will help gather quantifiable data on common needs (e.g., desired features, preferred alert mechanisms, budget constraints).

#### **3. Document Analysis:**

Reviewing current inventory records, sales data, and audit reports will help in understanding the required data structure, reporting needs, and integration points for the RFID system.

#### **4. Prototyping:**

Developing a low-fidelity prototype of the RFID interface can help gather iterative feedback, ensuring that the system aligns with user expectations before full-scale development.

### **Justification:**

Interviews are most appropriate because small businesses often lack formal documentation of their inventory processes and have unique, practical challenges that require direct understanding from those who manage and handle inventory daily. Through structured and semi-structured interviews, we can gather detailed insights about current workflows, pain points in manual inventory management,

expectations for the RFID system, and constraints related to budget and staff technical skills. Observation helps identify practical bottlenecks and errors in current inventory handling that staff may not explicitly mention. Questionnaires gather quantitative data across multiple businesses, identifying common requirements and acceptable features.

Questionnaires and surveys are valuable for collecting quantitative data from multiple businesses, helping identify *commonly needed features, user preferences, and budget constraints*, ensuring the system meets broader user expectations beyond a single business.

Document analysis helps us understand current record structures and reporting needs, aiding smooth integration with the RFID system. Prototyping with feedback ensures the system is intuitive and easy to use, addressing the limited technical background of small business staff.

Prototyping with feedback ensures the system is intuitive, easy to use, and aligned with user expectations, which is essential given the limited technical background of small business staff. It enables iterative refinement based on practical user input before full-scale development.

Together, these methods ensure a comprehensive, user-centered requirement discovery process, enabling the RFID inventory system to effectively reduce manual workload, enhance efficiency, and support small business operations practically.

## D2. Prepare a plan for the selected methods:

This structured plan ensures systematic data collection and validation of requirements, minimizing rework and aligning the system closely with real business needs.

Phase	Activity	Description	Timeframe
<b>1. Stakeholder Identification</b>	Identify key stakeholders	List small business owners, store managers, and inventory staff who directly manage stock and will use the RFID system. Include potential pilot customers for early feedback.	1 week
<b>2. Interviews</b>	Conduct interviews with stakeholders	Use targeted questions to understand current inventory workflows, key challenges, manual errors, and specific expectations from the RFID system, focusing on usability and cost concerns.	2 weeks
<b>3. Observation</b>	Observe current inventory processes	Spend 1-2 days per business observing inventory receiving, storing, and auditing to document bottlenecks, delays, and error-prone steps affecting daily operations.	2 weeks
<b>4. Surveys</b>	Distribute and collect surveys	Send structured questionnaires to gather client preferences on features, alert types, reporting needs, and budget limits, ensuring solutions meet broader market demands.	1 week
<b>5. Document Analysis</b>	Collect and analyze documents	Review existing inventory records, sales reports, and audit logs to identify data requirements and integration points that align with current record-keeping practices.	1 week
<b>6. Prototyping and Feedback</b>	Develop low-fidelity prototypes	Share interface prototypes with stakeholders to collect usability feedback, focusing on simplicity and relevance to daily tasks, then refine requirements accordingly.	2 weeks
<b>7. Requirement Documentation</b>	Consolidate and document requirements	Prepare a detailed Software Requirements Specification (SRS) categorized by functional and non-functional needs, validated by clients to ensure practical applicability.	1 week

### **D3. Identify all possible Functional Requirements (Tailored for Bangladesh Small Businesses):**

#### **1. RFID Tag Registration and Item Details:**

The system shall allow registration of inventory items with unique RFID tags, capturing essential details such as item name, category (e.g., groceries, textiles, electronics), quantity, purchase date, and expiry date for perishable goods.

#### **2. Real-Time Stock Movement Tracking:**

The system shall track item inflow and outflow automatically using RFID readers installed at storage points or checkout counters, providing immediate updates to inventory levels without manual intervention.

#### **3. Multilingual Dashboard:**

The system shall display stock levels, alerts, and reports on a dashboard with support for Bengali and English languages to accommodate owners and staff with varying language preferences.

#### **4. Mobile-Based Low Stock and Overstock Alerts:**

The system shall send automated SMS notifications and app-based alerts when stock levels cross predefined thresholds, considering the widespread use of mobile phones among small business owners.

#### **5. Item Search and Physical Location Identification:**

Users shall be able to search items by name or category and view their last known physical location within the shop or warehouse to reduce time spent locating goods in crowded or disorganized spaces.

#### **6. Simplified Inventory Audit Process:**

The system shall enable rapid inventory audits using handheld RFID readers or mobile devices, allowing staff to verify physical stock against recorded data quickly and efficiently.

#### **7. User Access Control with Simple Roles:**

The system shall have role-based access with three levels: Owner (full access), Manager (inventory updates and report viewing), and Staff (limited access for scanning and basic queries), ensuring data security and ease of management.

#### **8. Sales and Stock Reports with Basic Analytics:**

The system shall generate periodic reports (daily, weekly, monthly) on stock levels, sales trends, and product turnover to help business owners make informed restocking and sales decisions.

**9. Integration with Mobile Payment and Billing Systems:**

The system shall support integration or compatibility with common mobile payment and billing apps (like bKash, Nagad) popular in Bangladesh to streamline sales and inventory updates.

**10. Offline Mode with Data Sync:**

The system shall allow basic inventory operations offline with periodic data synchronization once internet connectivity is restored, considering inconsistent internet access in many small business locations.

**11. Export and Backup of Inventory Data:**

The system shall allow exporting inventory and sales reports in PDF and Excel formats for record-keeping, supplier communication, or accountant review.

**12. Customizable Item Categorization:**

The system shall allow business owners to create and manage custom categories relevant to their products (e.g., spices, textiles, cosmetics) for better inventory organization and reporting.

**D4. Identify at least five Non-Functional Requirements:**

**1. Scalability:**

The system should efficiently handle an increasing number of items and RFID tags as the business grows, without compromising performance.

**2. Usability:**

The system interface should be clean and intuitive, requiring minimal training for staff to operate confidently in daily inventory tasks.

**3. Reliability:**

The system should operate consistently with minimal downtime to ensure accurate, real-time inventory tracking at all times.

**4. Data Security:**

The system should enforce authentication and role-based access to prevent unauthorized changes or access to sensitive inventory data.

5. **Performance:**

The system should process and reflect changes in inventory within 5 seconds after scanning through RFID readers for real-time accuracy.

6. **Maintainability:**

The system should be designed for easy updates and bug fixes without affecting existing data or requiring major system overhauls.

7. **Cost-Effectiveness:**

The system should remain affordable for small businesses, minimizing hardware and operational costs while providing practical benefits.