Electronics Lab Inventory Management System (LIMS)

Overview

The purpose of this exercise is to give you an opportunity to showcase your engineering thought process, problem-solving skills, and technical creativity. We are more interested in your approach and how you justify your decisions than in finding a single "correct" answer. Please use the next 3-5 days to complete this assignment at your own pace.

General Instructions:

- **Submission Format:** Your final submission should be a single PDF document.
- **File Naming:** Please name your file in the following format: TeamName_CollegeName_A-1Launchpad.pdf.
- **Tools:** You are encouraged to use sketches, diagrams, and CAD software (if available to you) to illustrate your concepts. Hand-drawn sketches are perfectly acceptable if they are neat and clear.
- **Original Work:** This must be your own team work.

- **Deadline:** Please email your completed PDF to <mark>4th Aug,2025.</mark>

Objective:

Design, develop, and demonstrate a web-based inventory management system tailored for electronics R&D and manufacturing laboratories. The application must be accessible across various devices (mobile, tablet, desktop) and include specific notification triggers and dashboard functionalities.

Introduction to the Applicant:

Welcome to this self-paced case study! This exercise is designed to assess your full-stack development skills, including front-end, back-end, database design, and deployment considerations. You will have one week from the date of receiving this case study to develop and present your solution. Your task is to build a functional web application and host its codebase on a platform like GitHub (or an equivalent). Please document your design choices, explain your code, and provide clear instructions for setting up and running your application.

Problem Statement:

Electronics R&D and manufacturing labs typically deal with a vast array of components, ranging from passive elements to complex integrated circuits and specialized equipment. Efficiently managing this inventory is crucial for smooth operations, cost control, and preventing project delays due to stockouts or obsolete components. Manual tracking is prone to errors, time-consuming, and lacks real-time insights.

Your challenge is to develop a web-based inventory management system that addresses these pain points.

Core Requirements:

1. **Web Application:** Develop a full-stack web application accessible via a standard web browser.

2. **Device Responsiveness:** The user interface (UI) must be responsive and provide an optimal user experience across different devices (desktop, tablet, mobile phones).
3. **Component Management:**
   ○ Add new components to the inventory (Component Name, Manufacturer/Supplier, Part Number, Description, Quantity, Location/Bin, Unit Price, Datasheet Link, Category). **NOTE: Refer to the table at the end of the case study to be used as stock in the software.**
   ○ View all components.
   ○ Search and filter components by various criteria (name, part number, category, location, quantity range).
   ○ Edit component details.
   ○ "Inward" (add) and "Outward" (deduct) quantities of components. This should include who inwarded/outwarded, date/time, and reason/project.
4. **Notification Triggers:** Implement the following automated notification triggers (e.g., email, in-app pop-up, or a dedicated notifications section):
   ○ **Old Stock Alert:** Notify if components have been in inventory for more than 3 months without any outward movement.
   ○ **Low Stock Alert:** Notify when the quantity of a specific component falls below a predefined "critical low" threshold (configurable per component).
5. **Dashboard:** Create a dashboard providing a quick overview of key inventory metrics:
   ○ Graph/chart showing "Inwarded Items in a Month" (count of unique components or total quantity).
   ○ Graph/chart showing "Outwarded Items in a Month" (count of unique components or total quantity).
   ○ List of components with critically low stock.
   ○ List of components exceeding the 3-month retention period.
6. **User Authentication & Authorization:** Basic user login (e.g., username/password). Different roles (e.g., Admin, User) with varying permissions (e.g., Admin can add/edit users and manage all inventory, User can only inward/outward and view inventory).

Workflow:

● As an **Admin**, I want to add new users and assign them roles.
● As an **Admin**, I want to be able to define "critical low" thresholds for each component.
● As a **Lab Technician**, I want to quickly add new incoming components to the inventory.
● As a **Researcher**, I want to search for a specific resistor and see its quantity and location.
● As a **Manufacturing Engineer**, I want to log the usage of 50 pieces of a particular IC for a production batch.
● As an **Admin**, I want to see a graph of how many components were used last month.
● As an **Admin**, I want to receive an alert if a critical component is running low so I can reorder.
● As an **Admin**, I want to know which components are gathering dust on the shelf.

Deliverables:

Please submit the following by the end of the one-week period:

1. **GitHub Repository Link:** A link to your public GitHub repository containing:
   - Complete source code (front-end, back-end, database schema/migrations).
   - A comprehensive README.md file including:
     - Project overview.
     - Detailed instructions on how to set up and run the application locally.
     - Brief explanation of architecture and technology choices.
     - Description of implemented features.
     - Instructions for accessing different user roles (if implemented).
     - Screenshots or animated GIFs demonstrating key functionalities (especially responsiveness and dashboard/notifications).
     - Any known limitations or future improvements.
2. **Architecture & Design Document (PDF, max 3 pages):**
   - **High-Level Architecture Diagram:** Illustrating your chosen front-end, back-end, and database technologies, and how they interact.
   - **Database Schema Diagram:** Showing tables, relationships, and key fields.
   - **API Endpoints:** A list of major API endpoints and their purpose.
   - **Technology Justification:** Briefly explain why you chose specific technologies/frameworks.
   - **Scalability & Maintainability:** Briefly discuss how your design considers scalability and future maintainability.

Evaluation Criteria:

Your solution will be evaluated based on the following:

- **Functionality & Completeness:** Does the application meet all the core requirements? Are the notification triggers and dashboard working correctly?
- **Code Quality:** Readability, organization, comments, adherence to best practices, error handling.
- **Architecture & Design:** Appropriateness of chosen technologies, database design, API design, scalability considerations.
- **User Interface & Experience (UI/UX):** Responsiveness across devices, intuitiveness, ease of use.
- **Documentation:** Clarity and thoroughness of the README.md and design document.

- **Problem-Solving Approach:** How effectively you tackled the problem and addressed potential challenges.

Suggested List of Components and Their Quantities

This list is designed to provide a realistic, yet manageable, dataset for populating the inventory system. Applicants can use these as reference data for testing their application.

Categories:

1. **Resistors**
2. **Capacitors**
3. **Inductors**
4. **Diodes**
5. **Transistors**
6. **Integrated Circuits (ICs)**
7. **Connectors**
8. **Sensors**
9. **Microcontrollers/Development Boards**
10. **Switches/Buttons**
11. **LEDs/Displays**
12. **Cables/Wires**
13. **Mechanical Parts/Hardware**
14. **Miscellaneous Lab Supplies**

Component Details (Examples):

Category	Component Name	Manufacturer/Supplier	Part Number	Description	Quantity	Location/Bin	Unit Price (INR)	Critical Low Threshold
Resistors	Resistor (100 Ohm, 1/4W)	Generic	R100_1/4W	Carbon Film, 5% Tolerance	500	R-Shelf-A1	0.50	100

	Resistor (1k Ohm, 1/4W)	Generic	R1K_1/4W	Carbon Film, 5% Tolerance	500	R-Shelf-A1	0.50	100
	Resistor (10k Ohm, 1/4W)	Generic	R10K_1/4W	Carbon Film, 5% Tolerance	500	R-Shelf-A1	0.50	100
	Resistor (4.7 Ohm, 1W)	Generic	R4.7_1W	Metal Film, 1% Tolerance	150	R-Shelf-A2	1.20	30
Capacitors	Ceramic Cap (0.1uF, 50V)	Generic	C0.1UF_50V_CER	Ceramic Disc Capacitor	800	C-Bin-B1	0.80	200
	Electrolytic Cap (100uF, 25V)	Generic	C100UF_25V_EL	Radial Electrolytic Capacitor	200	C-Bin-B2	2.50	50
	Tantalum Cap (10uF, 16V)	KEMET	T491A106K016AT	SMD Tantalum Capacitor	100	C-Bin-B3	5.00	20

Inductors	Inductor (10uH)	Generic	L10UH	Radial Lead Inductor	100	L-Bin-C1	3.00	25
Diodes	1N4007 Diode	Fairchild	1N4007	Rectifier Diode, 1A, 1000V	300	D-Bin-D1	1.00	75
	Zener Diode (5.1V, 0.5W)	ON Semiconductor	1N5231B	Zener Diode	150	D-Bin-D2	1.50	30
Transistors	NPN Transistor (BC547)	NXP	BC547B	NPN BJT, General Purpose	200	T-Tray-E1	1.20	50
	MOSFET (IRF540N)	Infineon	IRF540N	N-Channel Power MOSFET	50	T-Tray-E2	25.00	10
Integrated Circuits (ICs)	NE555 Timer IC	Texas Instruments	NE555P	Precision Timer IC	80	IC-Box-F1	8.00	20
	LM358 Op-Amp	STMicroelectronics	LM358N	Dual Op-Amp	100	IC-Box-F2	6.00	25

	ATmega328P (DIP)	Microchip	ATMEGA328P-PU	Microcontroller, 8-bit	30	IC-Box-F3	150.00	5
	ESP32-WROOM-32U	Espressif	ESP32-WROOM-32U	Wi-Fi & Bluetooth Module	20	IC-Box-F4	200.00	3
Connectors	Male Header (2.54mm, 40-pin)	Generic	HDR-M-2.54-40	Single Row Pin Header	100	Conn-Drawer-G1	3.50	20
	JST-XH Connector (2-pin)	JST	B2B-XH-A(LF)(SN)	Through-hole, 2-pin	50	Conn-Drawer-G2	4.00	10
Sensors	DHT11 Temperature/Humidity	Aosong	DHT11	Digital Temperature & Humidity Sensor	15	Sensor-Bin-H1	50.00	3
	Photoresistor (LDR)	Generic	GL5516	Light Dependent Resistor	30	Sensor-Bin-H2	7.00	5
Microcontrollers/ Dev Boards	Arduino Uno R3	Arduino	A000066	Development Board	5	DevBoard-Rack-I1	800.00	1

	Raspberry Pi Zero W	Raspberry Pi Found.	RPI0W	Single-board Computer	3	DevBoard-Rack-I2	1200.00	1
Switches /Buttons	Tactile Push Button (6x6mm)	Generic	BTN-TACT-6X6	Momentary Tactile Switch	100	Switch-Box-J1	1.00	25
	SPDT Slide Switch	Generic	SW-SPDT-SLIDE	Single Pole Double Throw Slide Switch	40	Switch-Box-J2	3.00	10
LEDs/Displays	Red LED (5mm)	Generic	LED-RED-5MM	Standard Red LED	200	LED-Tray-K1	0.80	50
	16x2 LCD Display	Generic	LCD1602	Character LCD Module	10	LCD-Box-K2	150.00	2
Cables/ Wires	Jumper Wires (M-M, 40pc)	Generic	JMP-MM-40	Male-to-Male Jumper Wires, assorted	10	Cable-Bag-L1	80.00	2

	Hook-up Wire (22AWG, Red)	Generic	WIRE-22AWG-RED	Solid Core Hook-up Wire, 10m roll	5	Cable-Bag-L2	150.00	1
Mechanical Parts/Hardware	M3 Screws (10mm)	Generic	SCR-M3-10MM	Phillips Head, Steel	200	Mech-Bin-M1	0.50	50
	Brass Standoffs (M3, 10mm)	Generic	STDOFF-M3-10MM	Male-Female Standoff	100	Mech-Bin-M2	2.00	20
Miscellaneous Lab Supplies	Solder Wire (0.8mm)	Generic	SOLDER-0.8MM	Lead-free Solder, 100g roll	5	Misc-Shelf-N1	300.00	1
	Breadboard (Full Size)	Generic	BRDBRD-FULL	830 Tie Points	10	Misc-Shelf-N2	70.00	2

This list provides a good mix of common components and varying quantities/values, suitable for testing critical low stock, old stock, and general inventory operations. Applicants can add or modify components as they see fit for their demonstration.

We look forward to seeing your innovative solution.

Best of luck!