IVEN-TRON
AUTONOMOUS SMART WAREHOUSE SYSTEM

IVEN-TRON is a compact, low-cost autonomous robotic system designed to automate material handling, storage, and inventory tracking in small and medium-sized warehouses. By integrating robotics, embedded systems, and machine learning, IVEN-TRON improves operational efficiency, accuracy, and decision-making while remaining affordable and scalable.

WHAT? Strategy to prevent overstocking and stockouts?

WHY? Inventory records frequently mismatch physical stock

HOW? Reducing human handling to speed up operations

MARKET ANALYSIS

- Industry leaders (Amazon, AutoStore) use high-cost robotic systems.
- Traditional SMEs rely on manual labor with poor accuracy.

AutoStore

amazon

GAP	OPPORTUNITY
Affordable automation + predictive intelligence.	Low-cost robotic storage + RL-based demand prediction.

NEED IDENTIFICATION AND JUSTIFICATION

- Manual material handling in SME warehouses leads to delays, errors, worker fatigue, and inconsistent inventory records.
- Conventional solutions like forklifts and conveyors lack precision and are unsuitable for narrow or compact warehouse layouts.
- Unpredictable inflow of goods causes workflow disruptions and storage congestion.
- Manual inventory logging results in stock mismatches and financial losses.
- A compact, affordable autonomous system with real-time tracking and ML-based forecasting is required to improve efficiency and decision-making.

PROBLEM STATEMENT

Current warehouse operations in small to medium-scale enterprises are inefficient due to a heavy reliance on manual labor, lack of real-time inventory visibility, and the inability to predict fluctuating market demand. This results in operational bottlenecks, frequent human errors, and financial losses caused by stock mismanagement.

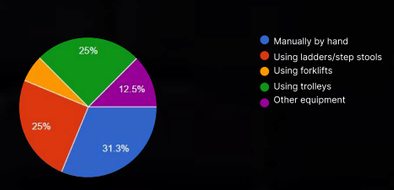
METHODOLOGY

PROJECT OVERVIEW

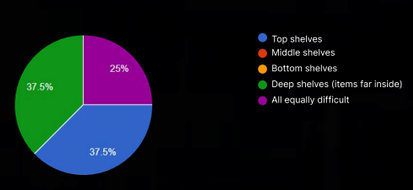
The project focuses on designing and developing an IoT-enabled smart warehouse automation system that autonomously handles, stores, and manages finished products without human intervention. To enhance operational efficiency, a ML model predicts daily production requirements based on demand patterns and stock levels, helping prevent both shortages and overstocking. Overall, the system addresses key challenges in modern warehouses such as manual dependency, inaccurate inventory tracking, inefficient storage utilization, and the need for intelligent, adaptive production planning.

USER SURVEY

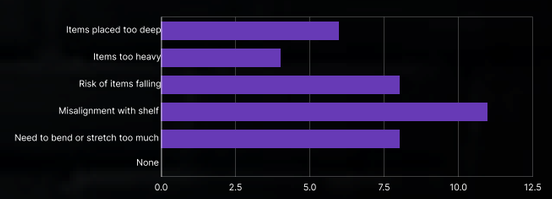
1. How do you currently pick items from shelves?



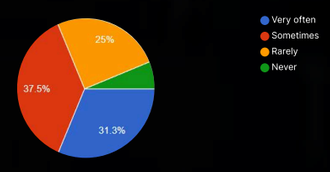
2. Which shelf levels are most difficult to access?



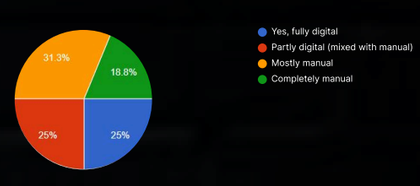
3. What challenges do you face while picting items?



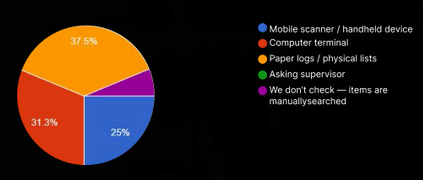
4. How often do items get stuck or damaged during picking?



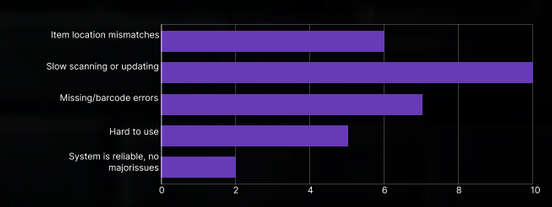
5. Does your warehouse use any digital inventory management system?



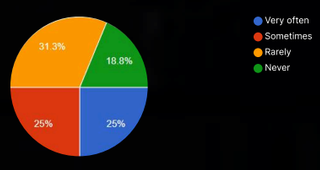
6. How do you currently check item availability or location?



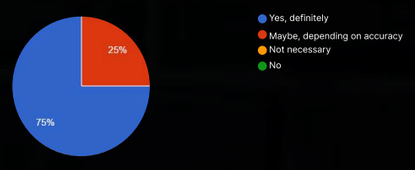
7. What problems do you face with the current inventory system?



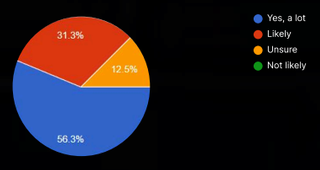
8. How often do you face out-of-stock or misplacement issues?



9. Would you prefer automation that updates inventory automatically?



10. Overall, how likely are you to support warehouse automation?



IDENTIFIED PROBLEMS

- Manual workflows create bottleneck, errors and safety risks.
- Paper logs cause visibility gaps and time lags.
- Storage decisions are not data-driven.
- SMEs lack integrated tracking + prediction tech.
- Industrial robots are expensive and infrastructure-heavy.

Course Code	DS3001
Course Name	Engineering Design - Including Design and Fabrication Project
Mentor	Dr. Sunil Aggrawal
Team	DFP - 38
Members	Animesh (23BDS013) Aditya Kumar (23BCS012) Ankit Raj (23BCS028) Aniket Mishra (23BEC016) Jigyasa (23BEC053) Tarun Gupta (23BSM062)

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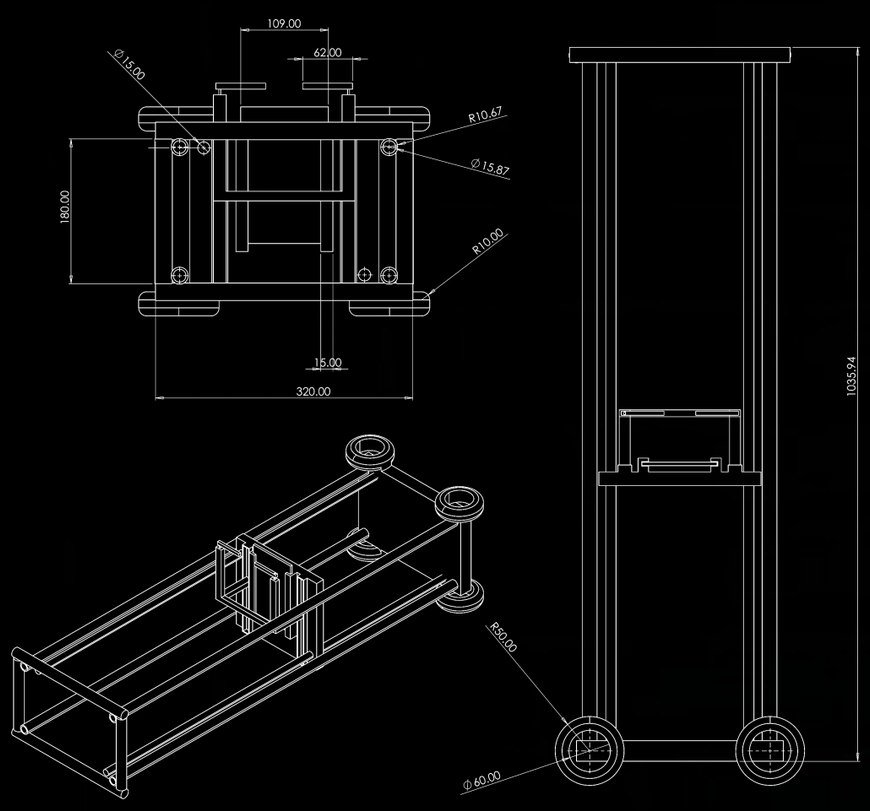
DESIGN DETAILING (Engineering Overview)

- IVEN-TRON is a compact, modular autonomous warehouse robot integrating mechanical, electrical, and software subsystems.
- A lightweight aluminum chassis with a gear-motor–driven vertical lift, linear guides, and limit switches ensures rigid structure and safe height adjustment.
- Box handling is performed using a servo-actuated U-shaped gripper supported by a sliding gap-bridge mechanism.
- The robot uses a differential-drive base with high-torque DC motors, assisted by IR, ultrasonic, and limit sensors for navigation and safety.
- An Arduino Mega with L298N motor drivers, a regulated 12 V power system, and wireless communication enables real-time inventory updates through a finite-state control architecture.

TECHNICAL DRAWING



UTILITY

Autonomous picking, lifting, and placing of items.	Real-time sensor-based inventory visibility.	RL-based demand prediction prevents shortages/excess.
Raw material monitoring with automatic alerts.	Low-cost tech suitable for SMEs.	Higher safety and efficiency with reduced human error.

BILL OF MATERIALS

COMPONENTS	QUANTITY	UNIT PRICE	TOTAL
MPU-6050 IMU	1	165	165
3mm IR Sensor	8	40	320
HC-SR04 Ultrasonic Sensor	4	61	244
11.1V 4200mAh Bonka LiPo	1	2857	2857
XT60 Connector Pair	1	25	25
XL4015 Buck Converter	2	71	142
AMS1117 3.3V	1	13	13
Imax B3 Charger	1	319	319
12V 2A Adapter	1	175	175
0.96in OLED Display	1	193	193
ESP32-CAM (OV3660)	1	629	629
BTS7960B 43A H-Bridge	4	254	1016
A4988 Stepper Driver	4	70	280
Metal Ball Caster	4	25	100
608ZZ Bearings	12	20	240
5mm to 8mm Flexible Coupling	4	52	208
Arduino Mega 2560 Pro	1	1447	1447
Arduino Nano R3	3	195	585
NEMA17 Stepper Motor	4	581	2324
Johnson 12V 60RPM Motor	4	538	2152
MG995 Servo Motor	3	226	678
HC-06 Bluetooth	2	275	550
10×4 cm Wheels (Pack of 4)	2	424	648
Acrylic Sheets (3pc) A4 Size	2	500	1000
Acrylic Plastic Fibre Sheets Cutter Hook Knife Blade	1	100	100
Soldering Iron 25W Gold with Advanced Heating Element	1	154	154
28BYZ-48 Stepper Motor 5V	4	83	332
Lead Screw 200mm (5 to 8 mm)	3	200	600
Pulley	4	100	400
Track Belt 40mm * 120 cm	4	235	940
Extras (Jumper Wire Set , LEDS, Resistor , etc)			700
Miscellaneous			2500
Wooden Shelf for Warehouse			1000
Grand Total			**23036**

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NOVELTY, COMPLETENESS, & FUNCTIONALITY

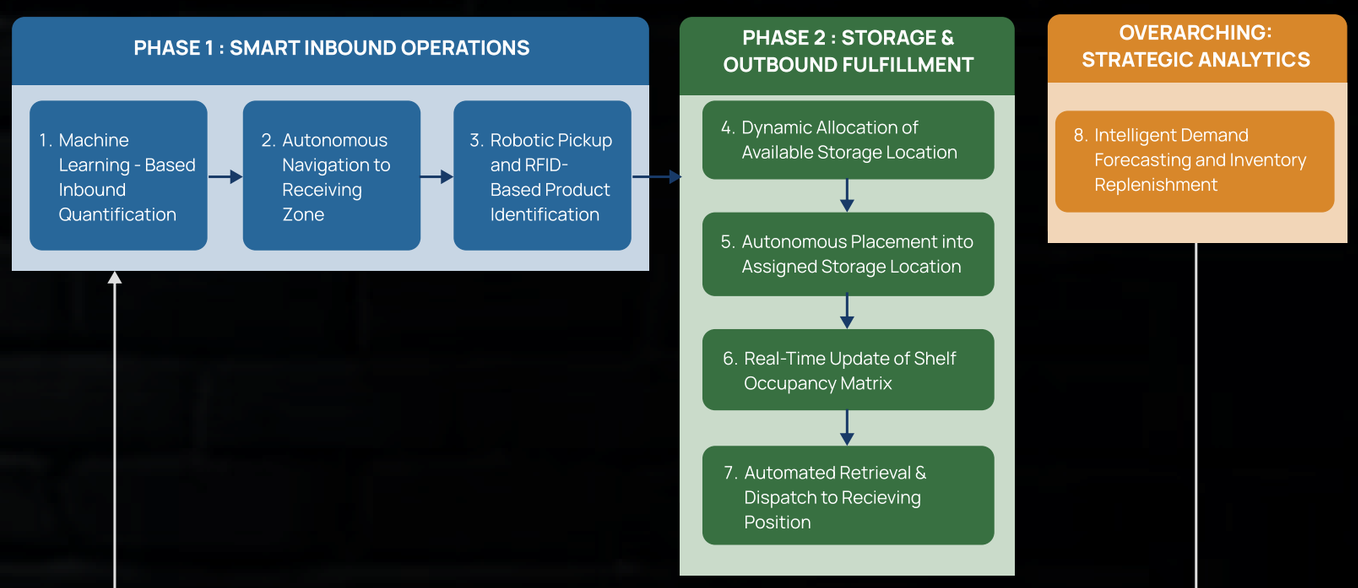
- Modular, compact, and cost-effective robot design that's easy to repair and maneuver in tight spaces.
- Fully autonomous flow: pickup → navigation → lifting → storage → digital inventory update.
- Customizable layout and operation based on user and warehouse requirements.
- RL-based forecasting optimizes production, reduces waste, and boosts profitability.
- Real-time IoT tracking enables accurate stock updates and low-material alerts.
- Unified smart-warehouse system combining robotics, IoT, and ML for complete automation.

WORKING

PROJECT LIMITATIONS AND IMPROVEMENTS

Limitation	Improvement
Low load capacity	Stronger frame and higher-torque motors
Only handles box-shaped items	Modular, interchangeable grippers
Limited onboard processing	Add edge-AI hardware for local computation
Cloud-dependent ML	Hybrid local–cloud processing
Basic IR/ultrasonic sensing	LiDAR or SLAM-based precise navigation
Restricted movement in tight spaces	Advanced path-planning and better localization
Short battery life	Hot-swappable batteries or auto-charging dock
Mechanical wear over time	Durable components and predictive maintenance
Limited scalability	Multi-robot coordination for larger warehouses

WORKFLOW



Scan for More Details

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