AI&ML

AI BUSINESS OPERATING SYSTEM

AI-Driven E-Commerce & Inventory Management Suite

Project Report

GROUP MEMBERS

- HASEEB AHMED – 70149250
- IRFAN GULZAR – 70145310
- ZAID QURESHI – 70149441
- MUHAMMAD JASIM – 70148943
- MUHAMMAD UMER – 70149306

SUBMITTED TO

DR. SYED MUHAMMAD HAMEDOON

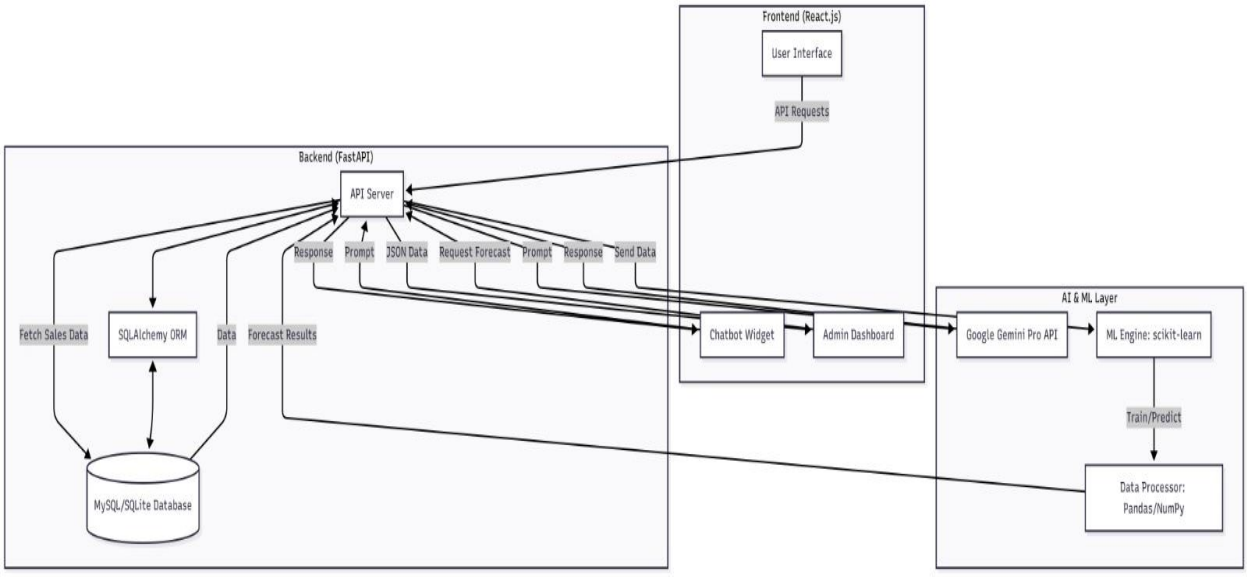
INTRODUCTION

AI-BOS (AI-Driven E-Commerce & Inventory Management Suite) is a comprehensive, full-stack intelligent platform designed to transform and modernize retail and e-commerce operations through the seamless integration of Artificial Intelligence, automation, and data-driven decision-making. The system goes beyond traditional e-commerce solutions by combining transactional capabilities with advanced analytics and AI-powered insights.

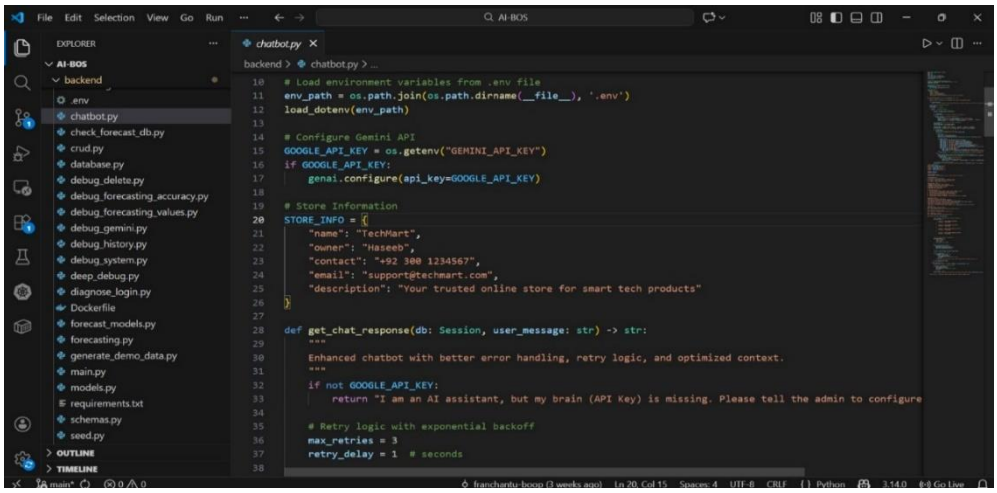
AI-BOS bridges the gap between conventional online retail systems and intelligent business management by enabling smart inventory control, demand forecasting, sales trend analysis, and personalized customer interactions. By leveraging machine learning models and real-time data processing, the platform helps businesses anticipate market demand, reduce stock shortages and overstocking, and optimize pricing and procurement strategies. The suite also enhances customer engagement through AI-driven recommendations, behavior analysis, and adaptive user experiences, allowing businesses to deliver more personalized and relevant offerings.

Overall, AI-BOS empowers retailers to make informed decisions, improve operational efficiency, reduce costs, and gain a competitive edge in the rapidly evolving digital commerce landscape.

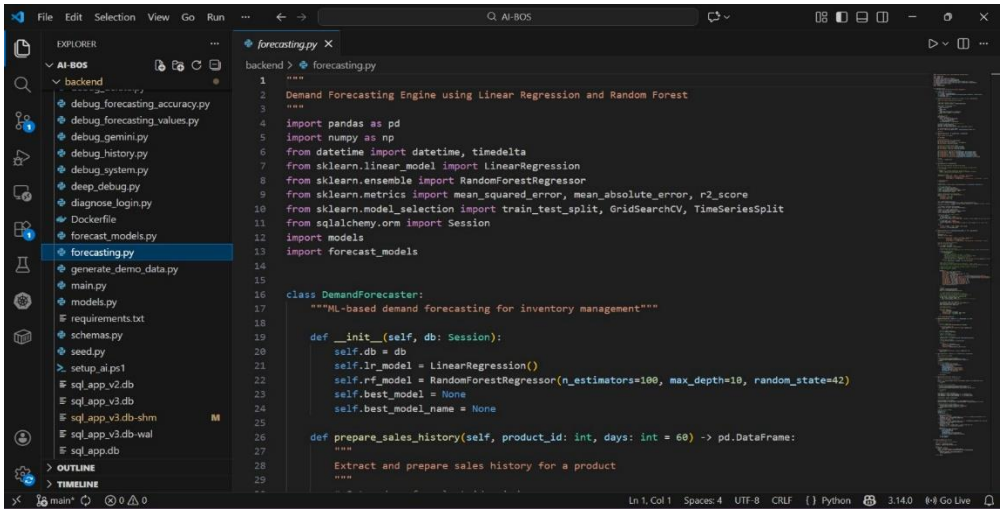
FLOW DIAGRAM



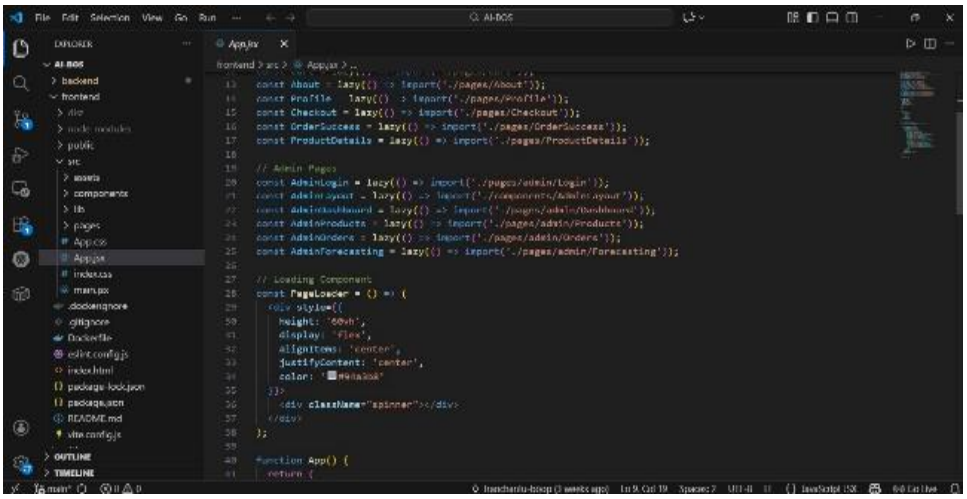
PROJECT CODE



```
# Load environment variables from .env file
env_path = os.path.join(os.path.dirname(__file__), '.env')
load_dotenv(env_path)

# Configure Gemini API
GOOGLE_API_KEY = os.getenv("GEMINI_API_KEY")
if GOOGLE_API_KEY:
    genai.configure(api_key=GOOGLE_API_KEY)

# Store Information
STORE_INFO = {
    "name": "TechMart",
    "owner": "Haseeb",
    "contact": "+92 300 1234567",
    "email": "support@techmart.com",
    "description": "Your trusted online store for smart tech products"
}

def get_chat_response(db: Session, user_message: str) -> str:
    """
    Enhanced chatbot with better error handling, retry logic, and optimized context.
    """
    if not GOOGLE_API_KEY:
        return "I am an AI assistant, but my brain (API Key) is missing. Please tell the admin to configure

    # Retry logic with exponential backoff
    max_retries = 3
    retry_delay = 1  # seconds
```

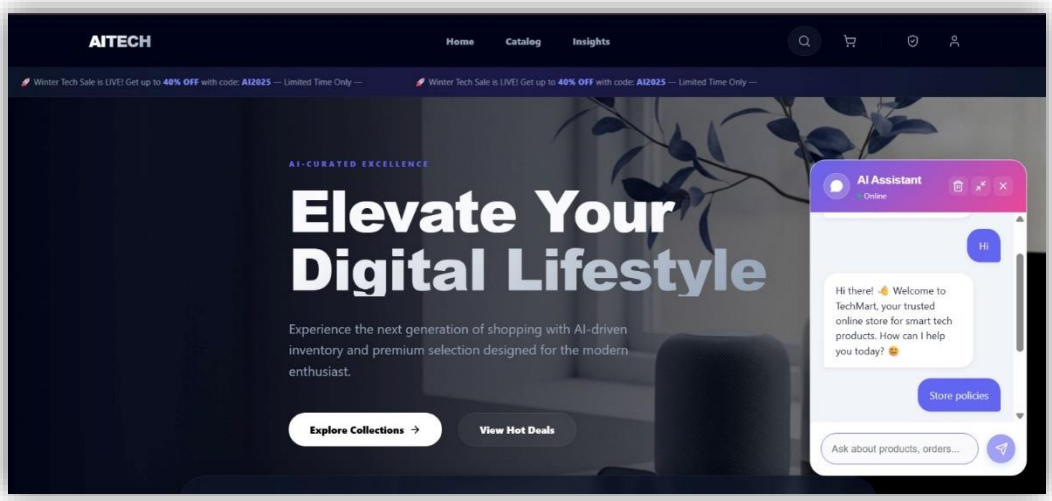


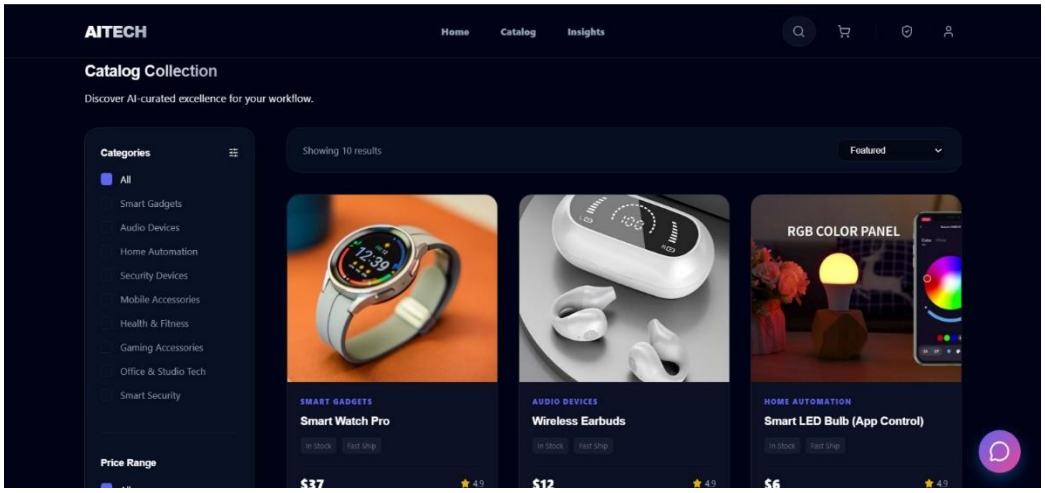
```
"""
Demand Forecasting Engine using Linear Regression and Random Forest
"""
import pandas as pd
import numpy as np
from datetime import datetime, timedelta
from sklearn.linear_model import LinearRegression
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_squared_error, mean_absolute_error, r2_score
from sklearn.model_selection import train_test_split, GridSearchCV, TimeSeriesSplit
from sqlalchemy.orm import Session
import models
import forecast_models


class DemandForecaster:
    """ML-based demand forecasting for inventory management"""

    def __init__(self, db: Session):
        self.db = db
        self.lr_model = LinearRegression()
        self.rf_model = RandomForestRegressor(n_estimators=100, max_depth=10, random_state=42)
        self.best_model = None
        self.best_model_name = None

    def prepare_sales_history(self, product_id: int, days: int = 60) -> pd.DataFrame:
        """
        Extract and prepare sales history for a product
        """
```

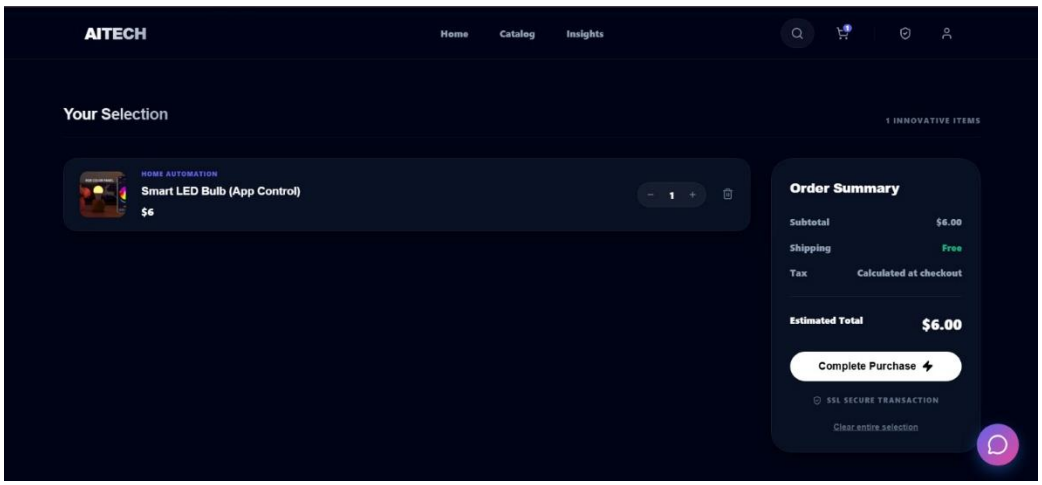


```
const About = lazy(() => import('./pages/About'));
const Profile = lazy(() => import('./pages/Profile'));
const Checkout = lazy(() => import('./pages/Checkout'));
const OrderSuccess = lazy(() => import('./pages/OrderSuccess'));
const ProductDetails = lazy(() => import('./pages/ProductDetails'));

// Admin Pages
const AdminLogin = lazy(() => import('./pages/admin/Login'));
const AdminLayout = lazy(() => import('./components/AdminLayout'));
const AdminDashboard = lazy(() => import('./pages/admin/Dashboard'));
const AdminProducts = lazy(() => import('./pages/admin/Products'));
const AdminOrders = lazy(() => import('./pages/admin/Orders'));
const AdminForecasting = lazy(() => import('./pages/admin/Forecasting'));

// Loading Component
const PageLoader = () => (
  <div style={{
    height: '60vh',
    display: 'flex',
    alignItems: 'center',
    justifyContent: 'center',
    color: '#4a3a58'
  }}>
    <div className="spinner"></div>
  </div>
);

function App() {
  return (
```

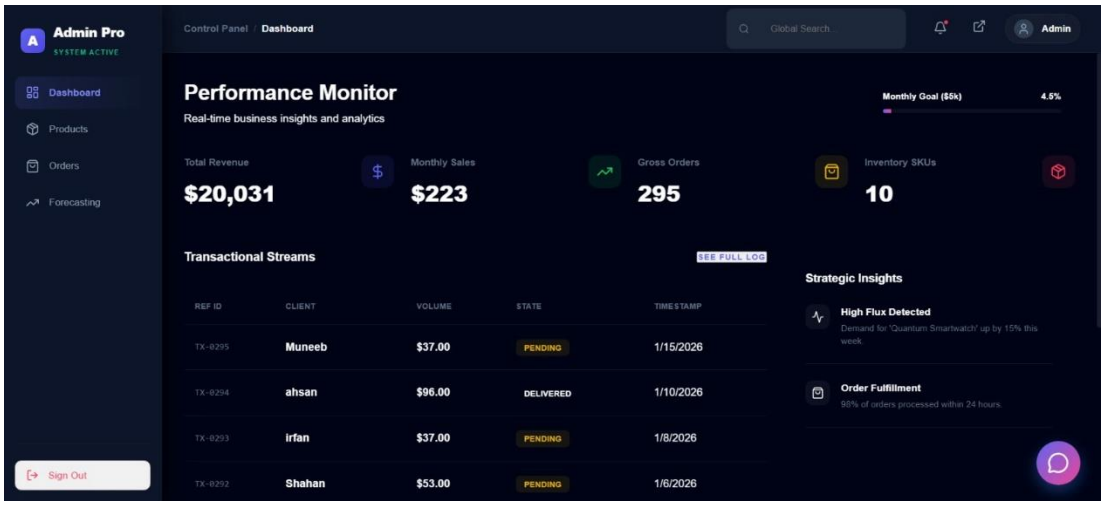
Project UI

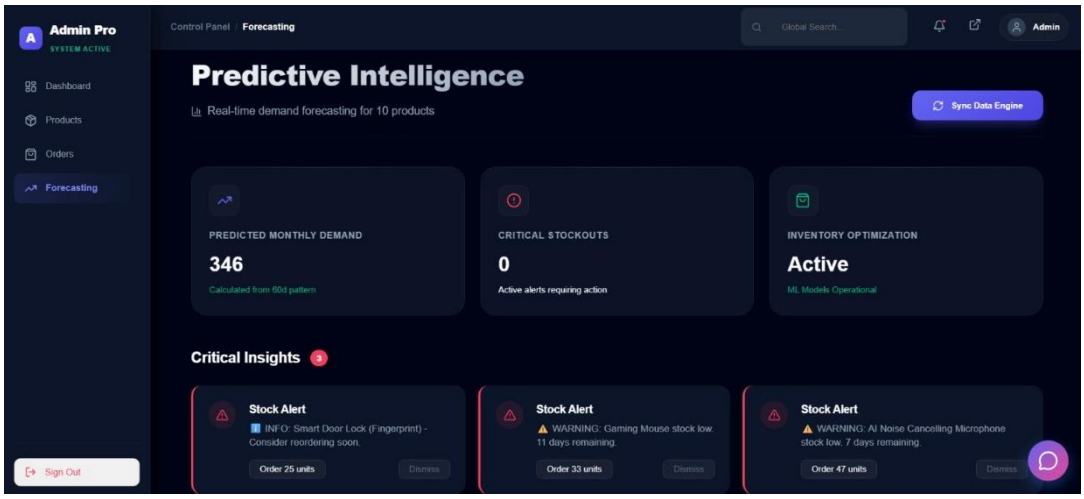

AITECH
Home
Catalog
Insights
Winter Tech Sale is LIVE! Get up to 40% OFF with code: AI2025 — Limited Time Only —
AI-CURATED EXCELLENCE
Elevate Your Digital Lifestyle
Experience the next generation of shopping with AI-driven inventory and premium selection designed for the modern enthusiast.
Explore Collections
View Hot Deals
AI Assistant
Online
Hi
Hi there! Welcome to TechMart, your trusted online store for smart tech products. How can I help you today?
Store policies
Ask about products, orders...

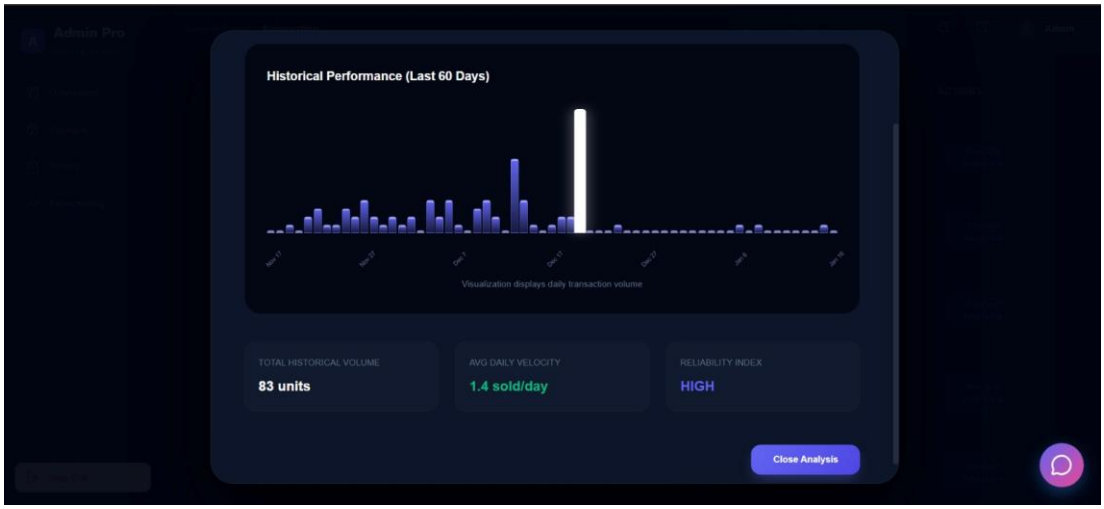

AITECH
Home
Catalog
Insights
Catalog Collection
Discover AI-curated excellence for your workflow.
Categories
All
Smart Gadgets
Audio Devices
Home Automation
Security Devices
Mobile Accessories
Health & Fitness
Gaming Accessories
Office & Studio Tech
Smart Security
Price Range
Showing 10 results
Featured
RGB COLOR PANEL
SMART GADGETS
Smart Watch Pro
$37
AUDIO DEVICES
Wireless Earbuds
$12
HOME AUTOMATION
Smart LED Bulb (App Control)
$6


AITECH
Home
Catalog
Insights
Your Selection
1 INNOVATIVE ITEMS
HOME AUTOMATION
Smart LED Bulb (App Control)
$6
Order Summary
Subtotal
$6.00
Shipping
Free
Tax
Calculated at checkout
Estimated Total
$6.00
Complete Purchase
SSL SECURE TRANSACTION
Clear entire selection

- **Admin Panel**


Admin Pro
SYSTEM ACTIVE
Dashboard
Products
Orders
Forecasting
Sign Out
Control Panel / Dashboard
Global Search...
Admin
Performance Monitor
Real-time business insights and analytics
Monthly Goal ($5k)
4.5%
Total Revenue
$20,031
Monthly Sales
$223
Gross Orders
295
Inventory SKUs
10
Transactional Streams
SEE FULL LOG
REF ID
CLIENT
VOLUME
STATE
TIMESTAMP
TX-0295
Muneeb
$37.00
PENDING
1/15/2026
TX-0294
ahsan
$96.00
DELIVERED
1/10/2026
TX-0293
irfan
$37.00
PENDING
1/8/2026
TX-0292
Shahan
$53.00
PENDING
1/6/2026
Strategic Insights
High Flux Detected
Demand for 'Quantum Smartwatch' up by 15% this week
Order Fulfillment
98% of orders processed within 24 hours


Admin Pro
SYSTEM ACTIVE
Dashboard
Products
Orders
Forecasting
Sign Out
Control Panel / Forecasting
Global Search...
Admin
Predictive Intelligence
Real-time demand forecasting for 10 products
Sync Data Engine
PREDICTED MONTHLY DEMAND
346
Calculated from 60d pattern
CRITICAL STOCKOUTS
0
Active alerts requiring action
INVENTORY OPTIMIZATION
Active
ML Models Operational
Critical Insights
3
Stock Alert
INFO: Smart Door Lock (Fingerprint) - Consider reordering soon.
Order 25 units
Dismiss
Stock Alert
WARNING: Gaming Mouse stock low. 11 days remaining.
Order 33 units
Dismiss
Stock Alert
WARNING: AI Noise Cancelling Microphone stock low. 7 days remaining.
Order 47 units
Dismiss


Historical Performance (Last 60 Days)
Visualization displays daily transaction volume
TOTAL HISTORICAL VOLUME
83 units
AVG DAILY VELOCITY
1.4 sold/day
RELIABILITY INDEX
HIGH
Close Analysis

Core System Modules

- **Conversational AI Core**

The Conversational AI Core is powered by the **Google Gemini Pro API** and provides an intelligent, context-aware chatbot capable of handling multi-turn conversations. It delivers instant and accurate customer assistance by understanding user intent and maintaining conversational context. This module enhances user engagement while significantly reducing the workload on traditional customer support teams.

- **Predictive Machine Learning Engine**

The Predictive Machine Learning Engine is built using **Scikit-Learn** and is designed to perform advanced time-series sales forecasting. It trains and evaluates multiple machine learning models, including **Linear Regression** and **Random Forest**, and automatically selects the most accurate **Champion Model**. This approach improves demand prediction accuracy and supports more effective business planning and decision-making.

- **Inventory Orchestration Unit**

The Inventory Orchestration Unit continuously monitors inventory levels in real time and evaluates potential stockout risks. Using future demand projections, it generates precise reorder quantity recommendations to maintain optimal stock levels. This module helps prevent both overstocking and shortages, ensuring smooth and efficient inventory operations.

- **High-End User Interface**

The High-End User Interface is developed using **React** and follows modern UI/UX design principles to deliver a premium user experience. It incorporates **Glass morphism** design elements and **Framer Motion** animations to create smooth, visually appealing interactions, resulting in a professional and engaging frontend interface.

Project Scope

The scope of AI-BOS includes the design and development of a scalable, AI-driven e-commerce and inventory management system that supports essential functionalities such as product management, order processing, inventory tracking, and customer interaction. The platform leverages artificial intelligence to perform demand forecasting, sales

analytics, and personalized recommendations, enabling businesses to optimize stock levels, reduce operational costs, and improve decision-making. The system also provides real-time dashboards, automated reporting, and secure role-based access, while being designed with extensibility and scalability to support future growth.

- **Future Enhancements**

Future enhancements of AI-BOS may include the integration of advanced machine learning models for improved forecasting and dynamic pricing, IoT-enabled real-time inventory tracking using RFID or smart sensors, and AI-powered chatbots for automated customer support. Additional improvements may involve mobile application development, multi-vendor marketplace support, blockchain-based transaction transparency, and enhanced fraud detection mechanisms. These enhancements will further strengthen the platform's intelligence, scalability, and adaptability to evolving e-commerce and retail needs.

GitHub Repo Link

Link: https://github.com/HaseebAhmad24-collab/AI-Driven-Ecommerce-Suite