AI-DRIVEN SUPPLY CHAIN DISRUPTION PREDICTOR AND INVENTORY OPTIMIZATION SYSTEM

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INTRODUCTION

- Supply chain disruptions arise from global events, demand fluctuations, and logistics issues.
- Leads to inventory imbalances, cost increases, and revenue loss.
- AI-driven predictive analysis ensures proactive risk management and operational efficiency.
- Main Objective - Monitor and analyze global supply chain data (news, suppliers, logistics).

CURRENT GAPS & CHALLENGES

- Lack of Real-Time Disruption Alerts
- Poor Predictive Capabilities
- Inefficient Inventory Optimization
- Limited Integration with External Data Sources
- Siloed Communication & Poor Collaboration
- Lack of Automation in Response Mechanisms

OBJECTIVES

- Predict inventory risks using machine learning.
- Improve inventory management by incorporating real-time data.
- Provide an intuitive user interface for inventory updates and risk analysis.
- Integrate Slack for immediate alerts on critical conditions.
- Enhance decision-making by analyzing sentiment and news impact.
- Automate restocking based on predictive risk levels.

TECHNOLOGIES USED

- **Programming Language:** Python 3.11
- **Python Libraries:** Gradio, Joblib, Scikit-learn, Pandas, NumPy, Ipywidgets, SQLite3, Matplotlib, Sumy (TextRank), Slack SDK
- **Data Source**: Event Registry, Kaggle
- **ML Model** : RandomForestRegressor
- **Transformer Model:** BERT
- **Deployment & Hosting:** Google Colab
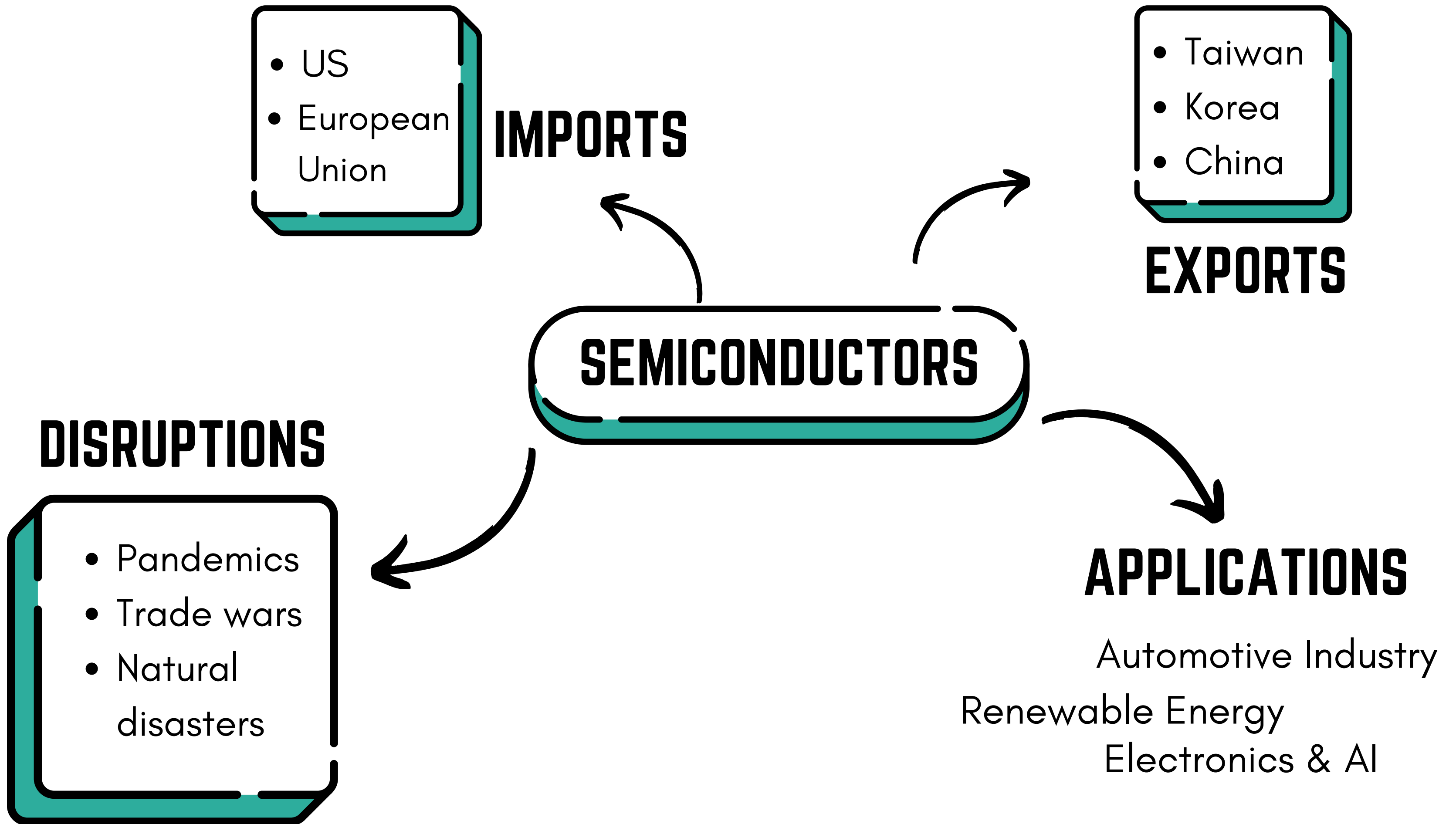- **Alerts & Notifications:** Slack Webhook

THE PROCESS FLOW

- Data Collection – Event Registry API
- Summarization
- Risk Factorization
- Inventory Management
- Alerts & Notifications

DATA PREPROCESSING

- Preprocessing: Cleaned and formatted data for analysis.
- **Sentiment Analysis:** Analyzed news sentiment to gauge its impact on inventory.
- **Risk Computation:** Combined sentiment with other features to compute risk.
- **Risk Labels:** Classify risks as High, Medium, or Low based on computed values.

IMPORTS
- US
- European Union

EXPORTS
- Taiwan
- Korea
- China

SEMICONDUCTORS

DISRUPTIONS
- Pandemics
- Trade wars
- Natural disasters

APPLICATIONS
Automotive Industry
Renewable Energy
Electronics & AI

ML MODEL FOR RISK PREDICTION

- RandomForestRegressor used for predicting risk factor.
- **Features:** Inventory levels, lead time, sentiment, and textual risk.
- **Risk Labels:** Model assigns risk labels (High, Medium, Low) based on predictions.
- Model trained on historical data, saved using joblib.
- Alerts are generated based on predicted risk factor values.

INVENTORY MANAGEMENT

- Tracks stock levels, sales, delays, and damages.
- Real-Time Alerts triggered for low stock, transport delays, or damages.
- Alerts when sales exceed stock or fall below purchase levels.
- Automatic restocking when stock drops below the threshold.
- Logged in the SQLite database for persistence.

UI - GRADIO

- Interactive inventory & risk UI
- Predict risk labels (High, Medium, Low)
- Real-time stock updates
- User-friendly interface for all
- Visualization of inventory & risk
- Instant predictions and alerts

Risk Prediction

Inventory Level

0.7

0 ———————————————●—————— 1

Lead Time (days)

76

0 ———————————————●——— 100

News Sentiment

0.6

-1 ——————————————————●— 1

Textual Risk

0.8

-1 ——————————————————●— 1

Clear   Submit

output 0

Risk Factor: 0.64

output 1

Risk Label: High

Flag

Update Inventory

Product

semiconductors

New Stock

200

Clear   Submit

output 0

```
1  ▼ {
2       "capacity": 1000,
3       "current_stock": 700,
4       "monthly_purchase": 200,
5       "monthly_sales": 250,
6       "minimum_stock": 100,
7       "damaged_stock": 0,
8       "transport_delay": false,
9       "selling_price": 15,
10      "cost_price": 10
11    }
```

output 1

WARNING: Monthly incoming stock is less than outgoing sales. Inventory may deplete soon.

Flag

Log Damaged Stock

Product

semiconductors

Damaged Quantity

250

Clear	Submit

output 0

```
1   ▼ {
2         "capacity": 1000,
3         "current_stock": 450,
4         "monthly_purchase": 200,
5         "monthly_sales": 250,
6         "minimum_stock": 100,
7         "damaged_stock": 250,
8         "transport_delay": false,
9         "selling_price": 15,
10        "cost_price": 10
11    }
```

output 1

Damaged stock logged: 250 units for semiconductors.
WARNING: High damage recorded! Investigate causes.

Log Transport Delay

Product

semiconductors

Delay Days

2

Clear	Submit

output 0

```
1   ▼ {
2         "capacity": 1000,
3         "current_stock": 450,
4         "monthly_purchase": 200,
5         "monthly_sales": 250,
6         "minimum_stock": 100,
7         "damaged_stock": 250,
8         "transport_delay": true,
9         "selling_price": 15,
10        "cost_price": 10
11    }
```

output 1

Transport delay logged for semiconductors: 2 days.
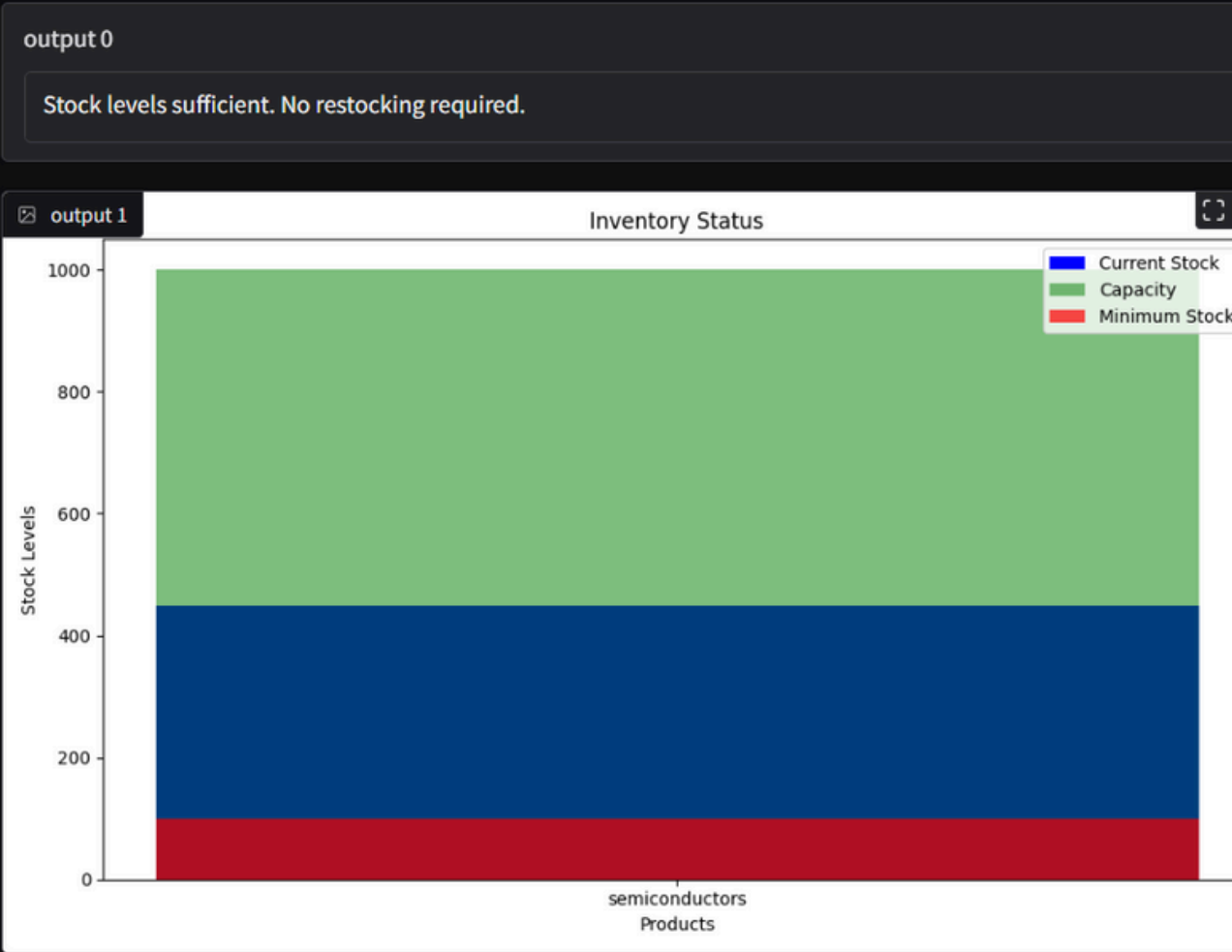WARNING: Transport delay may impact inventory replenishment.

Flag

Auto Restock

Product

semiconductors

| Clear | Submit |

output 0

Stock levels sufficient. No restocking required.

output 1 — Inventory Status

Log Sales Performance

Product

semiconductors

Sales Quantity

250

| Clear | Submit |

output 0

```
1  ▼ {
2      "capacity": 1000,
3      "current_stock": 450,
4      "monthly_purchase": 200,
5      "monthly_sales": 250,
6      "minimum_stock": 100,
7      "damaged_stock": 250,
8      "transport_delay": true,
9      "selling_price": 15,
10     "cost_price": 10
11 }
```

output 1

Monthly sales logged: 250 units for semiconductors.

SLACK FOR ALERTS & NOTIFICATIONS

- Slack notifications for risk conditions
- Alerts for high-risk, stock, delays
- Real-time inventory monitoring
- Actionable alerts for team guidance
- Slack setup via webhook

SLACK FOR ALERTS & NOTIFICATIONS

CONCLUSION

- AI-driven forecasting & risk prediction
- Real-time alerts & Slack integration
- Data-driven insights & automation

FUTURE SCOPE

- Multi-product system
- Real-time API integration
- Predictive analytics
- Business Tool Integration

THANK YOU