

Project ID:

25_26J_393

1. Topic (12 words max)

AI Driven Food Waste Reduction System with Social Media-Driven Demand Forecasting

2. Research group the project belongs to

TIM - Technology Integration and Management

3. Specialization of the project belongs to

Information Technology (IT)

4. If a continuation of a previous project:

Project ID	
Year	

5. Brief description of the research problem including references (200 – 500 words max) – references not included in word count.

The restaurant industry faces significant challenges in demand forecasting, inventory management, and waste reduction, with food waste alone costing the global food service industry over \$162 billion annually (NRA 2025). Traditional forecasting methods fail to capture the impact of viral social media trends on food demand, resulting in 38% forecast errors during viral events and leading to either 28% waste from overstocking or 22% lost sales from understocking.

Current restaurant management systems lack integration of real-time external factors such as social media virality, dynamic weather patterns, and competitor pricing strategies. Existing demand forecasting models use uniform multipliers for social media engagement (e.g., 10K views = +15% demand) without considering cuisine-type variations, content creator proximity, or trend velocity dynamics.

The research addresses four critical gaps:

- (1) absence of quantitative models translating social virality to dish-level demand,
- (2) limited probabilistic freshness prediction systems incorporating real-time storage conditions,
- (3) lack of AI-driven menu optimization for waste minimization, and
- (4) insufficient dynamic pricing models considering competitor strategies and promotional effectiveness.

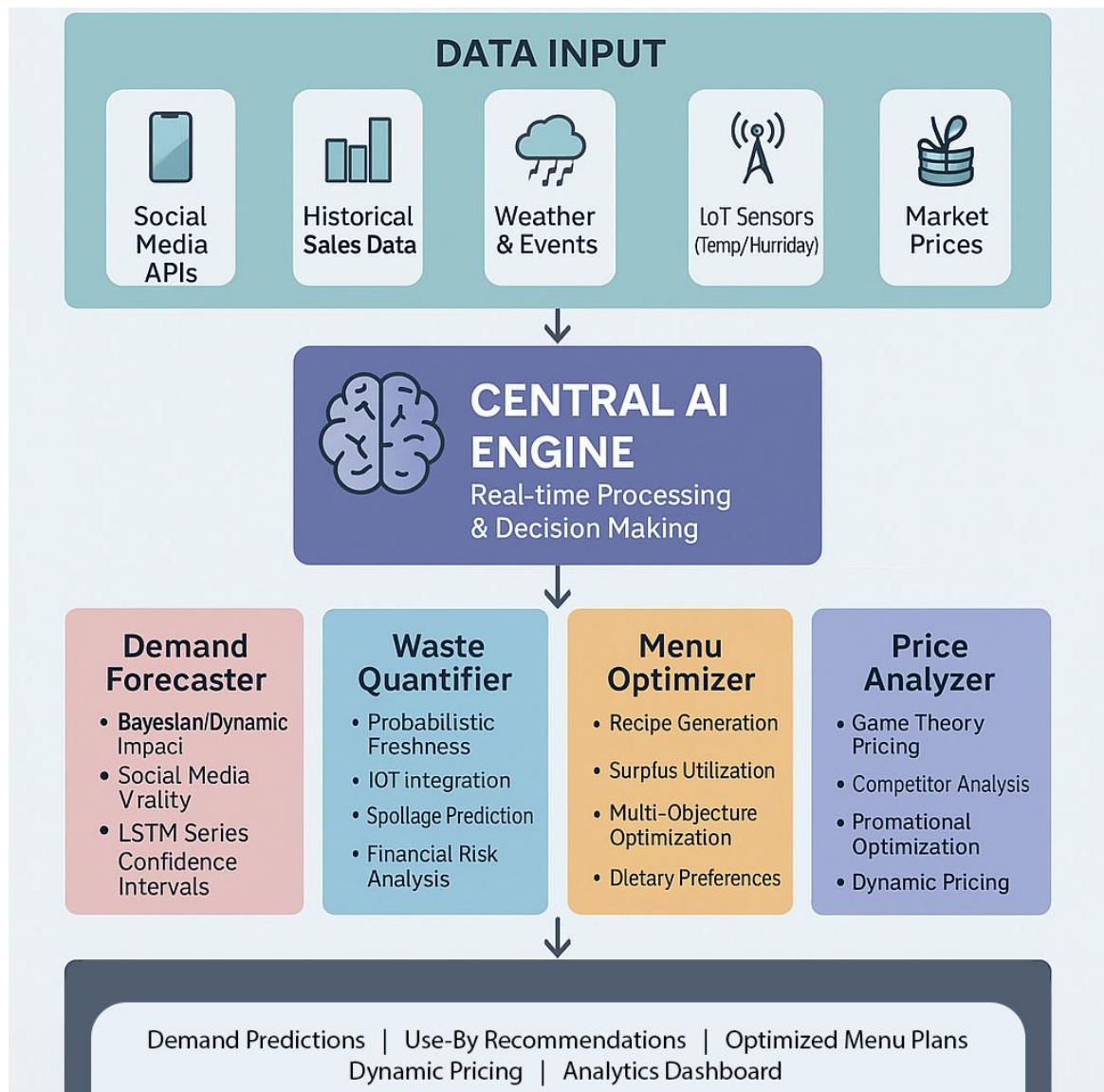
Previous studies have focused on single food items (Park & Jung, 2024) or static pricing models (Şahinbaş, 2022) without incorporating real-time market dynamics or cross-platform social media influence. The proposed system aims to achieve WMAPE <12% (vs. current 22%) in demand forecasting while reducing food waste by 25-30%.

References:

- Park, S., & Jung, K. (2024). "Machine Learning based Food Demand Estimation for Restaurants." *IEEE ISCON Conference Proceedings*.
- Şahinbaş, A. (2022). "Restaurant Price Prediction Using Machine Learning." *International Journal of Computer Science and Engineering*.
- National Restaurant Association (2025). "Food Waste and Demand Forecasting Industry Report."
- Singh, R., et al. (2023). "Social Sensing for Urban Food Security." *ACM SIGKDD Conference*.
- Chen, L., & Wang, M. (2024). "AI-Based Multi-Objective Optimization for Menu Planning Systems." *IEEE Transactions on Computational Intelligence*.

6. Brief description of the nature of the solution including a conceptual diagram (250 words max)

The proposed solution is an integrated AI-powered restaurant management system comprising four interconnected components:



The **Demand Forecaster** uses Bayesian Dynamic Impact Coefficients to convert social media engagement into calibrated demand predictions, incorporating cuisine-type variations and creator proximity. The **Waste Quantifier** employs a Probabilistic Freshness Network with real-time IoT sensor data to predict spoilage probability and provide use-by recommendations.

through a Sustainability-First Recipe Generator, while the **Price Analyzer** implements game theory-based dynamic pricing considering competitor strategies and promotional effectiveness history.

The system integrates LSTM networks for time-series forecasting, Natural Language Processing for social media analysis, and Multi-Objective Optimization algorithms for menu planning. Real-time data streams from Instagram/TikTok APIs, weather services, and IoT sensors enable continuous model adaptation and decision support.

7. Brief description of specialized domain expertise, knowledge, and data requirements (300 words max)

Domain Expertise Required:

- **Machine Learning & AI:** Deep learning architectures (LSTM, Transformers), Bayesian modeling, time-series forecasting, natural language processing for social media analysis
- **Data Science:** Statistical analysis, probabilistic modeling, feature engineering, model validation techniques
- **Business Intelligence:** Restaurant operations, supply chain management, pricing strategies, competitive analysis
- **IoT Systems:** Sensor integration, real-time data processing, edge computing for storage condition monitoring

Technical Knowledge Requirements:

- **Programming:** Python (TensorFlow, PyTorch, Scikit-learn), R for statistical analysis, SQL for database management
- **APIs & Integration:** Social media APIs (Instagram, TikTok), weather services, payment systems, POS integration
- **Cloud Computing:** AWS/Azure for scalable model deployment, real-time data processing
- **Visualization:** Tableau/Power BI for dashboard development
- **Web Development:** Dashboard creation for restaurant management interface

Data Requirements:

- **Historical Sales Data:** 2+ years of dish-level sales, seasonal patterns, customer preferences
- **Social Media Data:** Instagram/TikTok hashtag trends, engagement metrics, influencer data
- **External Data:** Weather forecasts, local event calendars, competitor pricing
- **IoT Sensor Data:** Temperature, humidity readings from storage areas
- **Market Data:** Real-time ingredient prices, supplier information
- **Customer Feedback:** Reviews, ratings, preference surveys

Specialized Datasets:

- Restaurant POS transaction logs (10,000+ entries)
- Social media content analysis (viral food posts, engagement metrics)
- Ingredient spoilage patterns and storage optimization data
- Regional pricing elasticity studies and competitive analysis reports

8. Objectives and Novelty

Main Objective			
Develop an integrated AI-powered restaurant management ecosystem that revolutionizes demand forecasting accuracy through social media trend analysis while achieving substantial waste reduction and profit optimization.			
Member Name with Registration No	Sub Objective	Tasks	Novelty
Thilakarathna W.P.N.S. IT22073846	Achieve <12% WMAPE in demand prediction through viral trend integration	<ul style="list-style-type: none"> • Develop Bayesian Dynamic Impact Coefficients • Implement cross-platform engagement analysis • Create dish-level demand calibration • Design confidence interval frameworks 	World's First Social Virality Quantification Model: Mathematical framework converting Instagram/TikTok engagement to precise demand increments with cuisine-specific coefficients
Alawaththa A.K.A.A. IT22249470	Reduce food waste by 30% through intelligent spoilage prediction	<ul style="list-style-type: none"> • Design Probabilistic Freshness Networks • Integrate IoT environmental monitoring • Develop Bayesian spoilage models • Create financial risk algorithms 	Adaptive Freshness Intelligence: Self-learning Bayesian network that adapts spoilage predictions to unique storage conditions and usage patterns

<p>Jayathunga A.G.I.A. IT22642950</p>	<p>Generate profitable recipes from surplus ingredients with 95% acceptability</p>	<ul style="list-style-type: none"> • Build sustainability-first recipe engines • Implement genetic algorithm optimization • Create ingredient substitution matrices • Design multi-constraint satisfaction 	<p>Culinary AI Creativity: First intelligent system generating commercially viable recipes from waste ingredients using evolutionary computing and sensory prediction</p>
<p>Fernando W.G.P.N. IT22261946</p>	<p>Optimize profit margins through competitive intelligence and game theory</p>	<ul style="list-style-type: none"> • Implement Nash equilibrium pricing • Develop competitor analysis engines • Create promotional effectiveness models • Design elasticity prediction systems 	<p>Game Theory Pricing Engine: Real-time competitive pricing using Nash equilibrium with historical promotional performance learning</p>

9. Individual component description of how it is complied with the specialization.

Member Name with Registration No	Description
<p>Thilakarathna W.P.N.S. IT22073846</p>	<p>Data Science Specialization Compliance: Implements advanced time-series forecasting using LSTM networks and statistical modeling. Develops feature engineering pipelines for social media data, applies Bayesian inference for uncertainty quantification, and creates predictive analytics dashboards. Utilizes big data processing techniques for real-time trend analysis and implements cross-validation methodologies for model performance evaluation.</p>
<p>Alawaththa A.K.A.A. IT22249470</p>	<p>Intelligent Systems Specialization Compliance: Designs probabilistic reasoning systems using Bayesian networks for spoilage prediction. Implements IoT sensor fusion algorithms, develops adaptive learning mechanisms for storage condition optimization, and creates intelligent alert systems. Applies machine learning techniques for pattern recognition in waste generation and builds autonomous decision-making systems for inventory management.</p>
<p>Jayathunga A.G.I.A. IT22642950</p>	<p>AI/ML Specialization Compliance: Develops genetic algorithms for menu optimization, implements multi-objective optimization using evolutionary computing, and creates natural language processing systems for recipe generation. Builds recommendation systems for ingredient substitution, applies deep learning for flavor profile analysis, and designs intelligent planning systems for menu adaptation based on multiple constraints.</p>

Fernando W.G.P.N.
IT22261946

Data Analytics Specialization Compliance: Implements game theory algorithms for competitive pricing, develops econometric models for price elasticity analysis, and creates business intelligence dashboards for pricing insights. Applies statistical analysis for market trend identification, builds predictive models for promotional effectiveness, and designs data visualization systems for pricing strategy communication.

10. Supervisor's details

	Title	First Name	Last Name	Signature
Supervisor	Mr	Ravi	Supunya	<i>Ravi</i> 25/06/2025
Co-Supervisor	Mrs	Chathanya	Kumarapperuma	<i>Chathanya</i> 26/06/2025
External Supervisor				
Summary of external supervisor's (if any) experience and expertise				

This part is to be filled by the Topic Screening Staff members.

a) Does the chosen research topic possess a comprehensive scope suitable for a final-year project?

Yes		No	
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b) Does the proposed topic exhibit novelty?

Yes		No	
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c) Do you believe they have the capability to successfully execute the proposed project?

Yes		No	
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d) Do the proposed sub-objectives reflect the students' areas of specialization?

Yes		No	
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e) Supervisor's Evaluation and Recommendation for the Research topic:

Acceptable: Mark/Select as necessary

Topic Assessment Accepted	
Topic Assessment Accepted with minor changes*	
Topic Assessment to be Resubmitted with major changes*	
Topic Assessment Rejected. Topic must be changed	

* Detailed comments given below

Comments

Staff Member's Name	Signature

***Important:**

1. According to the comments given by the evaluator, make the necessary modifications and get the approval by the **Evaluator**.
2. If the project topic is rejected, identify a new topic, and request the RP Team for a new topic assessment.