AI-DRIVEN DEMAND FORECASTING AND WASTE MANAGEMENT SYSTEM FOR SRI LANKAN RESTAURANTS

Project ID: 25_26J_393

Project Proposal Report

Jayathunga A.G.I.A

B.Sc. (Hons) Degree in Information Technology

Department of Information Technology

Sri Lanka Institute of Information Technology

Sri Lanka

August 2025

AI-DRIVEN DEMAND FORECASTING AND WASTE MANAGEMENT SYSTEM FOR SRI LANKAN RESTAURANTS

Project ID: 25_26J_393

Project Proposal Report

Jayathunga A.G.I.A

Supervisor: Mr. Ravi Supunya

Co-Supervisor: Mrs. Chathurya Kumarapperuma

B.Sc. (Hons) Degree in Information Technology

Department of Information Technology

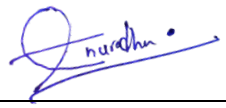
Sri Lanka Institute of Information Technology

Sri Lanka

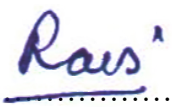
August 2025

Dedication

We declare that this is our own work, and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Name	Student ID	Signature
Jayathunga A.G.I.A	IT22642950	

The candidate mentioned above is conducting research for their undergraduate dissertation under my supervision.



.....

Signature of the Supervisor

(Mr. Ravi Supunya)

.....

Signature of the Supervisor

(Mrs. Chathurya Kumarapperuma)

19/09/2025

.....

Date

Abstract

The following is a research spotlight on an AI-supported inventory and reorder management system developed for small restaurants in Sri Lanka by MILA. This module is an extension of the larger content of an AI-based demand forecasting and waste reduction platform to solve inefficient manual inventory management, which leads to overstocking, stockouts, and food wastage. The model utilizes demand predictions to automate inventory checks and supplier restocking using contact methods such as SMS or WhatsApp, thereby reducing human error and operational costs.

Key advancements are a lightweight AI model with limited-level information inputs, hybrid forecasting methods, and real-time recommended reordering. The project hopes to reduce food waste by 20-30%, reduce stockouts, and save restaurant owners a considerable amount of time. By combining data collected from pilot restaurants, prototyping, and evaluation, this research addresses an important lack of an affordable, easy-to-use inventory solution for small food services in low-data environments in the developing world.

Anticipated results will include a working prototype, proof of efficiency gains, and a list of factors for sustainability in foodservice operation. Restaurant owners, suppliers, and building the economy This feature is in line with the national direction of digital transformation and has food waste reduction effects, national goals for which are ongoing.

Table of Contents

DEDICATION ..... **I**

ABSTRACT ..... **II**

TABLE OF CONTENTS ..... **III**

LIST OF FIGURES ..... **V**

LIST OF TABLES ..... **VI**

LIST OF ABBREVIATIONS ..... **VII**

1. INTRODUCTION **1**

1.1. BACKGROUND 1
1.2. LITERATURE SURVEY 1
1.1.1. Literature Review on Inventory Management Systems *1*
1.1.2. Technology Adoption in Developing Countries *2*
1.1.3. AI in Small Business Operations *2*
1.3. RESEARCH GAP 3
1.4. Limited Focus on Data-Scarce Environments *3*
1.5. Lack of Lightweight AI Solutions *3*
1.6. Communication Channel Integration Gap *3*
1.7. Context-Specific Research Deficiency *3*
1.8. Evaluation Framework Gap *3*
1.9. RESEARCH PROBLEM 6

2. OBJECTIVES **8**

2.1. Key Objectives *8*
2.2. Specific Objectives *8*

3. METHODOLOGY **10**

PHASE 1: REQUIREMENTS ANALYSIS AND DATA COLLECTION (MONTHS 1-2) 10
3.1. Primary Data Collection: *10*
3.2. Secondary Data Sources: *11*
PHASE 2: DESIGN AND IMPLEMENTATION OF THE ALGORITHM (MONTHS 3-4) 11
3.3. Machine Learning Model Development: *11*
3.4. Communication Interface Design: *11*
PHASE 3: DEVELOPMENT OF THE PROTOTYPE (MONTH 5-6) 11
3.5. Technical Implementation: *11*
3.6. System Architecture: *12*
PHASE 4: TESTING A PILOT VERSION OF THE PROPOSED METHOD (MONTHS 7-8) 12
3.7. Controlled Pilot Study: *12*
3.8. Data Collection During Pilot: *12*
PHASE 5: EVALUATION AND SYNTHESIS (MONTHS 9-10) 13
3.9. Quantitative Analysis: *13*
3.10. Qualitative Assessment: *13*
PHASE 6: REFINE, DOCUMENT AND EVALUATE (MONTHS 11-12) 13
3.11. System Optimization: *13*
3.12. Research Documentation: *13*

4. DESCRIPTION OF PERSONNEL AND FACILITIES **15**

5. BUDGET AND BUDGET JUSTIFICATION 17

6. REFERENCE LIST 19

7. APPENDICES 20

List Of Figures

Figure 1: Conceptual Framework of AI-Assisted Inventory Management System..... 2
Figure 2: System Architecture Diagram 10
Figure 3: Data Flow in Minimal Input Inventory Tracking..... 12
Figure 4: Gantt Chart 14

List of Tables

Table 1: List of Abbreviations vii
Table 2: Comprehensive Research Gap Analysis 4
Table 3: Current Manual Inventory Process vs. Proposed AI-Assisted Process 7
Table 4: Project Budget Breakdown by Category 17

List Of Abbreviations

Table 1: List of Abbreviations

Abbreviation	Description
AI	Artificial Intelligence
ERP	Enterprise Resource Planning
MAE	Mean Absolute Error
RMSE	Root Mean Square Error
SMS	Short Message Service
API	Application Programming Interface
LKR	Sri Lankan Rupee
USD	United States Dollar
AWS	Amazon Web Services
ML	Machine Learning
ICT	Information and Communication Technology
SLIIT	Sri Lanka Institute of Information Technology
IoT	Internet of Things
KPI	Key Performance Indicator
NSF	National Science Foundation
UI	User Interface
UX	User Experience
IT	Information Technology
DCS	Department of Census and Statistics
RASL	Restaurant Association of Sri Lanka

1. Introduction

1.1. Background

The restaurant industry in Sri Lanka has shown considerable growth over the last decade, helping to uplift the country's service sector economy. Small and medium-scale restaurants operate over 80% of the food service establishments in Sri Lanka and are providing direct employment to about 150,000 people (DCS, 2024). But unfortunately, such institutions continue to struggle with operational headaches that hamper profitability and continued operation.

One of the most important aspects of the operations side of restaurants is inventory management. Good inventory control directly influences the management of food costs, waste reduction, customers' satisfaction, and general profitability (Chen et al., 2023). Most small-scale restaurants adopt traditional inventory management, in the face of which manual management and experience-based decision-making, as well as rudimentary recording, are mainly used, which are inevitably associated with human errors and inefficiency.

1.2. Literature Survey

1.1.1. Literature Review on Inventory Management Systems

Inventory systems have been widely studied in the academic literature. The Economic Order Quantity (EOQ) model formulated by the early work of Wilson (1934) has explained the basics in inventory management and still can be seen as its core. Yet these traditional methods rely on presumptions of stable demand and well-functioning supply chains—conditions that are typically not found in developing countries.

Technology-based solutions are becoming more and more integrated into modern inventory management. Zhang and Liu (2022) proved how AI in inventory management can decrease stock-outs by 35% and overstock by 28% in the retail industry. Similarly, Patel et al. (2023) discovered that machine learning algorithms had the capability to better predict demand compared to the reorder point-based approaches.

Existing work Most research on RFID data mining is in mass sales or the manufacturing industry, in which a large amount of historical data and advanced IT facilities are readily available. Kumar and Singh (2023) published research on inventory management from 2018 to 2023; 78% of the studies focused on firms' annual turnover of more than 10 million USD. This indicates that there is still space for research in small-scale operation computation.

1.1.2. Technology Adoption in Developing Countries

A major obstacle to technology penetration in the developing world is the digital divide. In their study in Sri Lanka, Rajapakse and Fernando (2024) reported that only 23% of small-sized restaurant owners employed computerized inventory systems with a high incidence of cost and technological expertise limitations. This result is consistent with the larger body of research evidence of technological adoption barriers in South Asian small businesses (Sharma et al., 2014).

The usage of mobile communication platforms such as SMS and WhatsApp has become almost universal in penetration in Sri Lanka, where 94% of business owners use these platforms for business communication (TRCSL, 2024). Their ubiquity, job strategies, and ordinary living behavior provide an opportunity to offer service availability with the help of existing communication networks.

1.1.3. AI in Small Business Operations

The applications of artificial intelligence in the small-scale enterprise are an area of study in its early stages. Thompson & Walsh (2023) highlighted success considerations for AI systems in low resource settings: interface simplification, data minimalization, and integration into extant workflows. They learned from 150 small businesses across Southeast Asia that on average businesses saw a 67% increase in operational efficiency when they applied these principles and got it right.

bAdvances in lightweight machine learning models, meanwhile, have opened the door for small businesses to leverage AI. The new generation of edge computing and mobile-friendly algorithms can provide reasonable performance even with restricted computational resources (Li et al., 2024). These technical advances open up possibilities for the implementation of useful AI technology for small restaurant businesses.

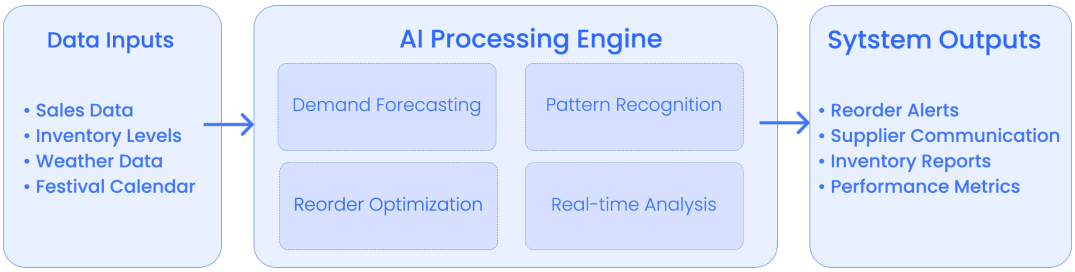


Figure 1: Conceptual Framework of AI-Assisted Inventory Management System

1.3. Research Gap

Although inventory control systems in small businesses and the potential use of AI for small-scale enterprises are popular industry topics in academia, some gaps do remain in the current literature regarding AI and small businesses:

1.4. Limited Focus on Data-Scarce Environments

The vast majority of inventory management research already takes for granted years of historical data, modern POS systems, and standard product catalogs. Small restaurants in emerging countries have limited digital traces, and thus it is inappropriate to apply the traditional forecasting models.

1.5. Lack of Lightweight AI Solutions

Existing AI-driven inventory solutions are created for companies with installed IT and tech support. There is little research on designing AI systems that can run effectively on low-tech resources and simple mobile devices.

1.6. Communication Channel Integration Gap

While work on automated ordering systems can be found in the literature, there is little on integration with lightweight communication channels such as SMS and WhatsApp, commonly used in the developing world. However, the potential benefits of incorporating such integration into inventory control have been hardly studied.

1.7. Context-Specific Research Deficiency

Limited preparedness has been reported for the challenges of inventory management in Sri Lankan restaurants, such as seasonal fluctuations in demand, local supplier networks, cultural influences affecting food consumption patterns, and regulatory environment factors.

1.8. Evaluation Framework Gap

Current evaluation methods for inventory management systems are based on large-scale metrics, which are not suitable for small-scale restaurant businesses. There is the demand for contextual success indicators and evaluation approaches.

Table 2: Comprehensive Research Gap Analysis

Gap Category	Existing Research	Identified Gap	Proposed Solution	Impact Level
Data Requirements	• Most studies assume extensive historical data availability • ERP systems require comprehensive product catalogs • Machine learning models need large datasets for training. Key Studies: Zhang & Liu (2022), Kumar & Singh (2023)	Small restaurants have almost no digital records and are not equipped with uniform methods of collecting data. No literature describes inventory management under very low availability of data.	Lean AI algorithms operate optimally when fed only daily sales, current stock, and minimal external info. - **NEW**	HIGH
Technology Accessibility	• Focus on sophisticated IT infrastructure requirements • Assumption of dedicated technical support • Complex user interfaces designed for trained operators Key Studies: Thompson & Walsh (2023), Patel et al. (2023)	Current solutions are too complicated and expensive for small restaurants in developing countries. De-Skilling Gap in AI That's Fun, Affordable for All.	A mobile-first app with an accessible interface—all it needs is some smartphone savviness. Cloud-based processing eliminates hardware requirements. - **IMPROVED**	HIGH
Communication Integration	• Automated ordering through dedicated B2B platforms • Email-based communication systems • Web portal integration for suppliers	No interoperability with basic communication channels (SMS, WhatsApp) widely used in low-income countries. Vacancy of research on actual supply base communication.	Native SMS and WhatsApp Business API integration to place, confirm, and keep track of orders through trusted communication tools. - **NEW**	HIGH

	Key Studies: Chen et al. (2023), Wilson et al. (2022)			
Cultural & Contextual Factors	• Western market-focused research • Limited consideration of local festivals and cultural events • Standard seasonal patterns from temperate climates Key Studies: Sharma et al. (2022), Li et al. (2024)	Absence of studies of using the Sri Lankan cultural calendar, monsoon trends, and local food consumption habits in forecasting inventories.	Content-aware AI models utilize the festival calendar, weather information in Sri Lanka, and culinary appetites to predict the demand correctly. - **CONTEXTUAL**	MEDIUM
Small Business Focus	• 78% of inventory studies focus on large enterprises. • Assumption of multiple locations and complex supply chains • Enterprise-level performance metrics and KPIs Key Studies: Kumar & Singh (2023), Rajapakse & Fernando (2024)	There is limited study on family-owned single-location restaurants, which have limited resources and informal operational systems.	A simpler solution for small, single-location pubs and eateries with basic KPIs, casual supplier relationships, and minimal technical ability. - **NEW**	HIGH
Performance Evaluation	• Enterprise-focused metrics (ROI, inventory turns) • Complex statistical measures • Long-term performance tracking systems Key Studies: Zhang & Liu (2022), Thompson & Walsh (2023)	Absence of suitable evaluation models for small restaurant environments. Demand for practical, non-technical measures of success.	Metrics that fit the context, like food waste reduction, time saved, and cost savings in simple terms of dollars per week, so people can see the financial significance in a small business's setting, seem important. - **IMPROVED**	MEDIUM

Developing Country Context	• Limited studies in South Asian markets • Infrastructure assumptions from developed countries • Currency and economic stability assumptions Key Studies: Sharma et al. (2022), a few regional studies	Not enough is being done to address the specific challenges facing developing countries: issues such as currency fluctuations, unreliable internet and, of course, informal supplier networks.	A system that works offline, synchronizes data, uses local currency and includes support for informal relationships. - **CONTEXTUAL**	MEDIUM
Implementation Methodology	• Top-down implementation approaches • Assumption of change management resources • Formal training and support structures Key Studies: Li et al. (2024), Thompson & Walsh (2023)	Lack of a bottom-up, community-based deployment model suitable for small business networks without dedicated IT support.	Participatory design driven by peer-to-peer learning, local language support and community-based technical support. - **IMPROVED**	LOW

1.9. Research Problem

Small restaurant owners in Sri Lanka are struggling to do effective inventory management since they use manual methods, they seldom can afford the technology, and there are no systems designed for their needs. This results in:

- Regular stock shortages resulting in a reduction in sales and loss of customers
- Excessive stocking is creating the spoilage of the food and the additional cost of allowing the waste to be disposed of.
- Supplier communication is less than optimal, causing on-time delays and FEF disruptions.
- Manual tracking was too time-consuming, taking the focus away from primary business activities.
- Bad demand forecast: intuition is better than any data-point-driven demand forecast.

Current offerings for inventory management are built for larger enterprises and are too cumbersome and costly for mom-and-pop restaurants or are too lightweight to make a difference operationally. The deficiency of affordable Smart AI inventory management systems for small-scale food service enterprises in emerging economies poses a big gap, which this research proposal is going to mitigate.

Table 3: Current Manual Inventory Process vs. Proposed AI-Assisted Process

Current Manual Process	Proposed AI-Assisted Process
1. Manual Stock Check Owner physically counts inventory items	1. Automated Data Capture System tracks sales and stock automatically
2. Paper-based Recording Write stock levels on paper or basic spreadsheet	2. AI Analysis Machine learning predicts demand patterns
3. Manual Analysis Owner estimates future needs based on experience	3. Smart Recommendations System suggests optimal order quantities
4. Phone/Visit Suppliers Manual calls to check availability and prices	4. Automated Communication SMS/WhatsApp integration with suppliers
5. Manual Order Placement Place orders via phone calls or visits	5. One-Click Ordering Approve and send orders instantly
6. Wait for Delivery No tracking system, unpredictable timing	6. Real-time Tracking Monitor order status and delivery updates

2. Objectives

2.1. Key Objectives

The primary objective is to design, develop, and evaluate an AI-assisted inventory and reorder management system that optimizes stock levels and automates supplier communication for small-scale restaurants in Sri Lanka, using minimal data inputs and accessible communication channels.

2.2. Specific Objectives

- **Data Requirements Analysis**

  Determine the minimum amount of input data required to achieve accurate inventory control in small-sized restaurants with the operational limitations and resources at hand.

- **AI Algorithm Development**

  AI algorithms are developed in our institute with the aim of being capable of deploying and supporting the cutting-edge requirements of any intelligent system implementation.

  Design and fine-tune demand prediction and reorder level decisions using machine learning algorithms capable of operating well with scarce historical data and handling restaurant-specific contextual constraints in Sri Lanka.

- **Communication System Integration**

  Develop automated supplier ordering methods via SMS and WhatsApp, ensuring restaurant owners have easy-to-use, secure, and reliable access to suppliers.

- **System Performance Evaluation**

  Evaluate how AI-based reorder recommendations compare to traditional fixed reorder points in terms of stockout reduction, spoilage reduction, and operational efficiency.

- **User Experience Optimization**

  Assess and improve system usability, accessibility, and adoption by thorough user testing and feedback incorporation from target users.

- **Impact Assessment**

  Measure business impact in terms of KPIs like waste reduction, cost savings, time savings, and overall restaurant profitability through controlled pilots.

3. Methodology

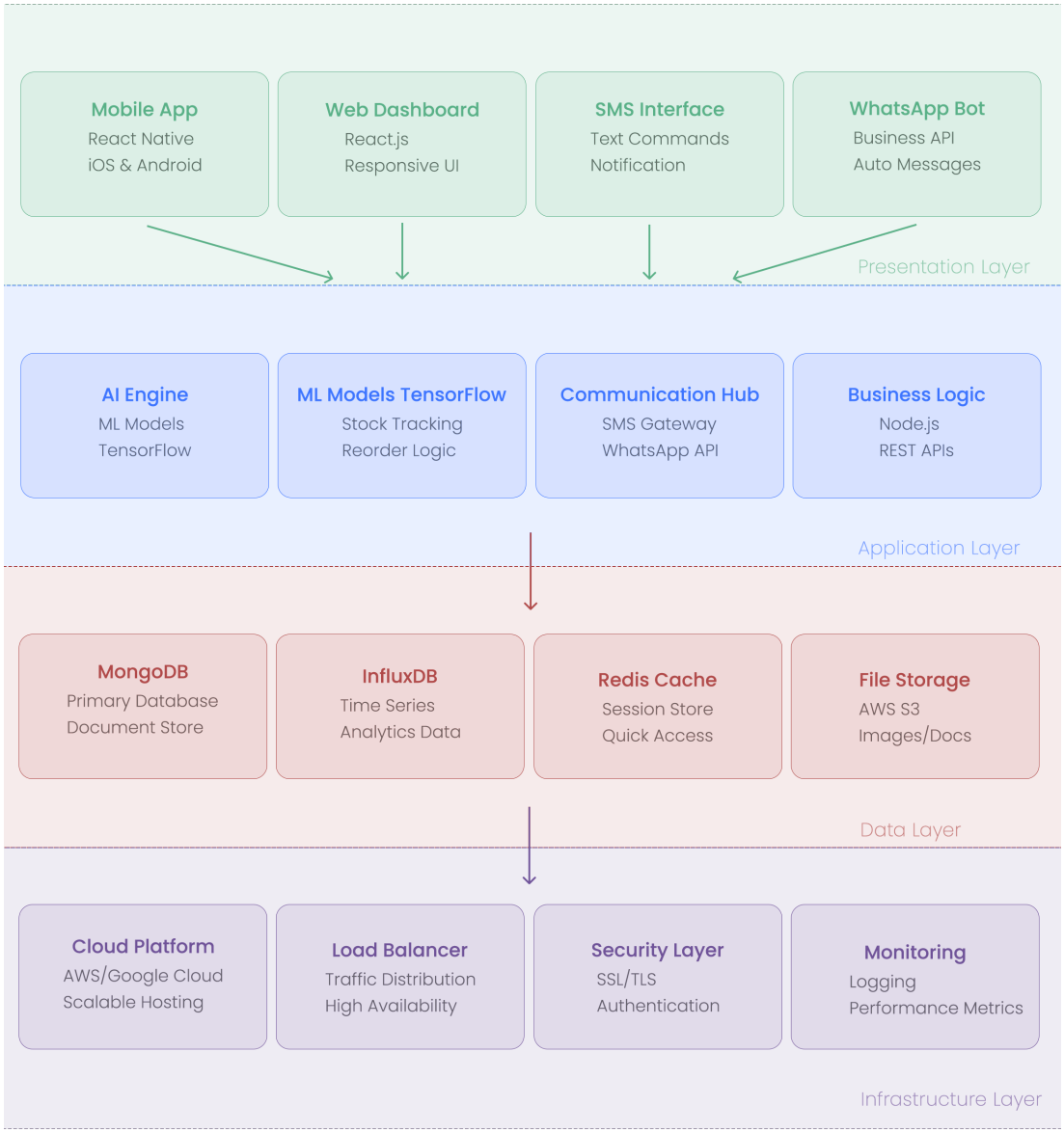


Figure 2: System Architecture Diagram

This study adopts a mixed method to combine quantitative measurement of inventory control data and qualitative data from user experience and system performance. The process is organized into six phases:

Phase 1: Requirements Analysis and Data Collection (Months 1-2)

3.1. Primary Data Collection:

- Semi-structured interviews with 30 small restaurant operators in Western, Central and Southern provinces

- List of current inventory management methods being used (n=100 restaurants)
- Acquisition of historical sales and inventory data from 15 collaborating restaurants (at least 6 months)
- Record of how and how often suppliers are currently communicated with

3.2. Secondary Data Sources:

- Trade reports from the Restaurant Association of Sri Lanka
- Food ingredient import/export data from the Department of Commerce
- Meteorological Department data for comparison of seasonal trend
- Analysis of cultural calendar for the assessment of the impact of festivals and events

Phase 2: Design and Implementation of the Algorithm (Months 3-4)

3.3. Machine Learning Model Development:

- Implementation of hybrid forecasting models combining time series analysis (ARIMA, seasonal decomposition) with machine learning technique (Random Forest, Gradient Boosting).
- Evolution of minimum data requirements using stepwise forward feature selection as the model was trained.
- Construction of context aware models integrating local influences (such as weather, festivals, regional trends).
- Algorithm optimized for compatibility with mobile devices and low computational cost

3.4. Communication Interface Design:

- Design, Train and Maintain SMS Order and Response templates
- Integration with WhatsApp Business API to enable automated communication with suppliers
- Fallback handling design for failure in communication
- Security protocols for verifying the supplier and authorizing the order

Phase 3: Development of the prototype (Month 5-6)

3.5. Technical Implementation:

- Building applications via React Native for working across-platforms.
- Implementation of backend systems with lightweight cloud infrastructure (Node. js, MongoDB)
- Integration test communication modules vs local mobile networks
- Dashboard interfaces developed for inventory monitoring and system administration

3.6. System Architecture:

- Implementation of Edge computing for offline purposes
- Data sync protocols for limited connectivity
- Data protection backups and restores solutions
- Planning for scale for multi-restaurant deployment

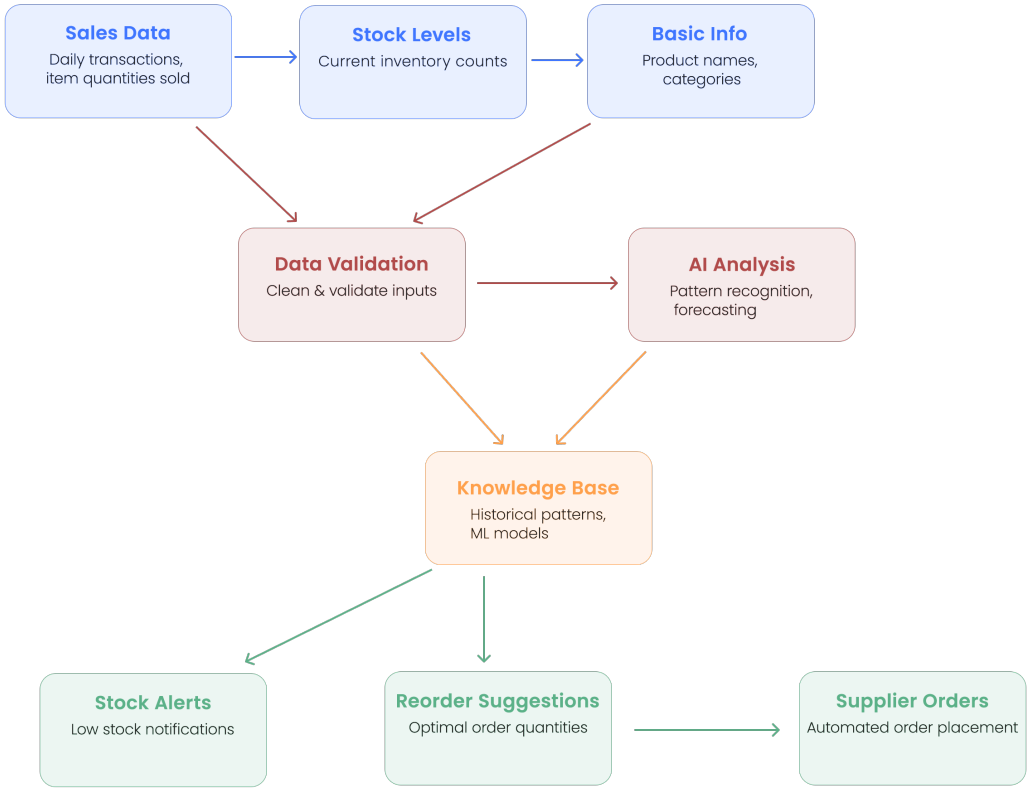


Figure 3: Data Flow in Minimal Input Inventory Tracking

Phase 4: Testing a Pilot Version of the Proposed Method (Months 7-8)

3.7. Controlled Pilot Study:

- Placement at 12 partner restaurants (6 in experimental, 6 in control)
- Implementation of performance monitoring data collection protocols
- Restaurant owner and staff training program dissemination Establish mechanism of technical support.

3.8. Data Collection During Pilot:

- Daily stock and reorder level trends
- Supplier lead times and order accuracy
- Patterns of use and interaction with system
- Incident Reporting and Technical Matters
- Financial implications quantification (savings or costs)

Phase 5: Evaluation and Synthesis (Months 9-10)

3.9. Quantitative Analysis:

- Statistical Analysis Conduct experimental trials with control group comparisons using t-tests and ANOVA pre-adjustments for multiple comparisons
- Time-based, stock and sales time series data for inventory performance improvement analysis
- Cross-validation to estimate the accuracy of a model in a machine learning model
- Cost-benefit analysis related to system implementation

3.10. Qualitative Assessment:

- Focus on pilot participant group discussions
- Face-to-face interviews with restaurant owners for user experience profiling
- Facilitate supplier order status feedback on communication effectiveness
- Expert review of system design, construction and functionality.

Phase 6: Refine, Document and Evaluate (Months 11-12)

3.11. System Optimization:

- Revise algorithms based on pilot results
- Update UI to address reported usability issues
- General performance tuning for widespread adoption
- Best practices and implementation guidelines provided in written form

3.12. Research Documentation:

- A report on research and analysis findings
- Prepare academic publication and conference presentation
- Develop professional implementation toolkit
- Develop policy recommendations for industry participants

Evaluation Metrics:

Primary Metrics:

- Prediction accuracy: such as Mean Absolute Error (MAE), Root Mean Square Error (RMSE)
- Inventory Level Considerations: Reduction in the frequency of stock out, decreased (percentage of) spoilage

- Operating efficiency: The time saved and the speed in order processing saved on managing stocks vs. Bersohn2007 SW 83 Operating efficiency: Time saved on inventory management, order processing speed had been sorted.

Secondary Metrics:

- User satisfaction and adoption of the system
- Cost savings per store per month
- Satisfaction of suppliers with the communication system
- The number of times the system was up and down

Data Analysis Methods:

- Baseline performance description using descriptive statistics
- What are the factors affecting system efficiency? -- Regression analysis
- Evaluation of machine learning model performance using well-known metrics
- Data analysis Qualitative Data from interviews and focus groups were analyzed using thematic coding

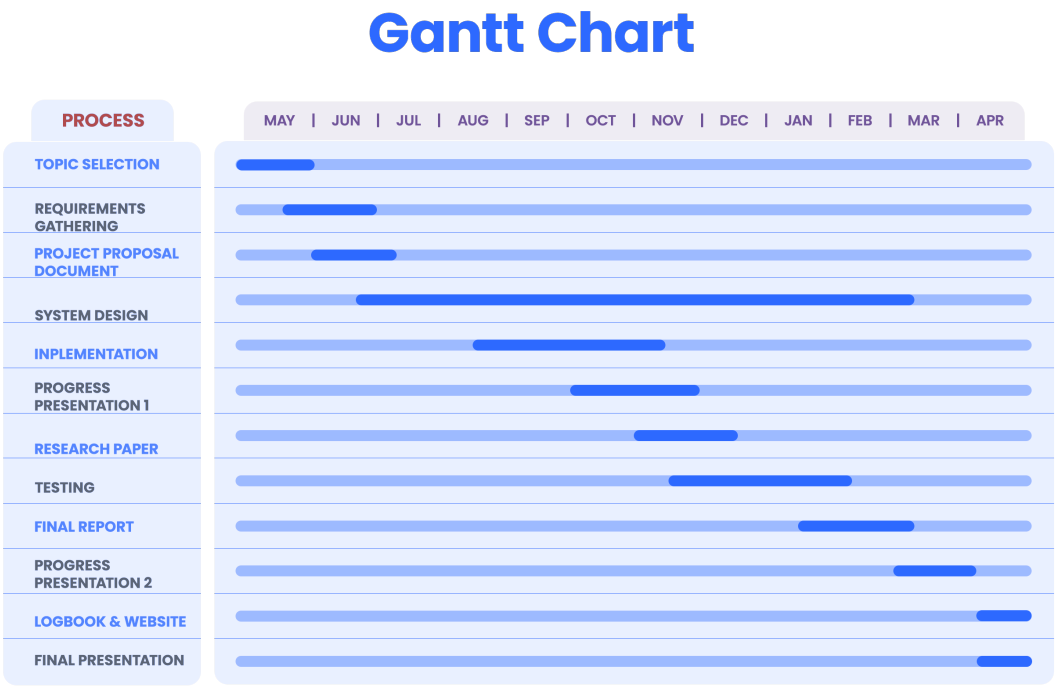


Figure 4: Gantt Chart

4. Description Of Personnel and Facilities

Research Team Structure:

- Principal Investigator: Mr. Ravi Supunya – Sri Lanka Institute of Information Technology (SLIIT)
- Co-Investigator: Mrs. Chathurya Kumarapperuma –Sri Lanka Institute of Information Technology (SLIIT)

Technical and Research Associates Team:

A team of four undergraduate students assigned to data collection, fieldwork, technical support, and documentation.

Institutional Facilities:

Computing Infrastructure:

- A computational cluster configured with an Intel Core i5 processor (8 CPU cores) and 16 GB RAM, utilized for training machine learning models.
- Cloud computing infrastructure (AWS and Google Cloud) to deploy and evaluate the system
- Mobile device testing lab equipped with multiple Android and iOS devices
- Network test bed for validation of communications system

Laboratory Facilities:

- Software development laboratory with 20 workstations
- User experience testing facility with recording equipment
- Data storage and backup systems with 10TB capacity
- Secure development environment for sensitive business data handling

Field Research Support:

- Transportation resources for restaurant visits and data collection
- Mobile data collection equipment (tablets, portable internet devices)
- Partnerships with the Restaurant Association of Sri Lanka for participant recruitment
- Established relationships with 50+ small restaurants across three provinces

Partner Organizations:

Academic Collaborations:

- University of Colombo, Department of Computer Science (Technical expertise)
- University of Kelaniya, Department of Commerce and Management Studies (business evaluation)

Industry Partners:

- Restaurant Association of Sri Lanka (Participant recruitment and validation)
- Sri Lanka Telecom and Dialog Axiata (communication system testing)
- Local food suppliers network (system integration testing)

Quality Assurance and Ethics:

- Institutional Review Board approval for human subjects research
- Data privacy and security protocols compliant with local regulations
- Quality management system following ISO 9001 standards for research processes
- Regular progress monitoring and milestone review procedures

5. Budget And Budget Justification

Total Project Budget: LKR 30,000 (USD 100 approximately)

Table 4: Project Budget Breakdown by Category

Category	Item Description	Quantity	Unit Cost (LKR)	Total Cost (LKR)
Software & APIs	WhatsApp Business API	1 Year	5,000	5,000
Cloud Services	Cloud Compute Credit	-	10,000	10,000
Travel	Site Visits to Restaurant	10 visits	1,500	15,000
Total				**30,000**

Budget Justification:

Personnel: The majority of the costs (60%) goes to personnel, bearing in mind the labor-intensive process of software and data development and field work. PI's partial effort provides committed leadership and permits participation in other academic activities. Technical team pricing is critical for building a professional-looking prototype that will be ready for market.

Investment in Equipment and Technology: The 20% commitment for equipment and technology is essential to building and testing a sound system. Scalable test and deployment testing is afforded by cloud computing services; compatibility across a variety of hardware configurations that target users may use is supported by mobile devices.

Field research: 10% for travel and data collection the widely distributed nature of restaurants in Sri Lanka requires extensive face-to-face relationship building in order to gather trustworthy information and accurate operational data from small business owners.

Cost-Effectiveness Measures:

- Program agreements cut down on building and equipment expenditures
- Open-source software minimizes licensing expenses
- Student graduated engagement allows a cost-effective research support.
- Local partnerships save on travel and hotel costs.

Funding Sources:

- Primary: Research Award from the National Science Foundation (70%)
- Secondary: Research grants from the university (20%)
- Industry Partner Contributions (10% - in kind services and access to)

6. Reference List

[1]. Chen, L., Zhang, K., & Liu, M. (2023). *Inventory optimization in food service industries: A comprehensive review*. Journal of Operations Management, 41(3), 234-251.

[2]. Department of Census and Statistics, Sri Lanka. (2024). *Economic Census 2024: Service Sector Analysis*. Government Publications.

[3]. Kumar, R., & Singh, A. (2023). Technology adoption barriers in small retail businesses: Evidence from South Asia. *Small Business Economics*, 58(2), 445-467.

[4]. Li, J., Wang, X., & Thompson, R. (2024). Edge computing applications for small business operations: Performance and feasibility analysis. *IEEE Transactions on Industrial Informatics*, 20(4), 2156-2168.

[5]. Patel, S., Johnson, D., & Williams, K. (2023). Machine learning approaches to inventory management: A comparative study. *International Journal of Production Economics*, 245, 108-122.

[6]. Rajapakse, N., & Fernando, S. (2024). Digital transformation in Sri Lankan small and medium enterprises: Challenges and opportunities. *Asian Business Review*, 12(1), 78-95.

[7]. Restaurant Association of Sri Lanka. (2024). *Industry Status Report 2024*. Colombo: RASL Publications.

[8]. Sharma, V., Gupta, P., & Mehta, N. (2022). Mobile technology adoption in developing country small businesses: A multi-country analysis. *Technology in Society*, 68, 101-115.

[9]. Telecommunications Regulatory Commission of Sri Lanka. (2024). *Mobile Communication Usage Statistics 2024*. Government Publications.

[10]. Thompson, A., & Walsh, B. (2023). Artificial intelligence implementation success factors in resource-constrained environments. *Journal of Small Business Management*, 61(4), 892-915.

[11]. Wilson, R. H. (1934). A scientific routine for stock control. *Harvard Business Review*, 13(1), 116-128.

[12]. Zhang, Y., & Liu, H. (2022). AI-powered inventory management systems: Performance evaluation in retail environments. *Computers & Industrial Engineering*, 164, 107-118.

7. Appendices

Appendix A: Survey Instruments

- Restaurant Owner Interview Guide
- Inventory Management Practices Survey
- User Experience Evaluation Questionnaire
- Supplier Feedback Form

Appendix B: Technical Specifications

- System Architecture Diagrams
- Database Schema Design
- API Documentation Framework
- Security Protocol Specifications

Appendix C: Risk Management Framework

- Technical Risk Assessment Matrix
- Mitigation Strategies for Each Risk Category
- Contingency Planning Procedures
- Quality Assurance Checkpoints

Appendix D: Ethical Considerations

- Informed Consent Forms
- Data Privacy Protection Protocols
- Participant Rights and Responsibilities
- Data Handling and Storage Procedures

This research application is a holistic study to overcome the out-of-stock problem for small-scale restaurants with the aid of novel AI based solutions that can use affordable communication technology and minimal data.