

Smart Supply Chain Cost Analytics and Profit Prediction System for Micro-SMEs

R26-IT-026



TEAM INTRODUCTION



**MR.DEEMANTHA
SIRIWARDANA**
SUPERVISOR



**MISS.AYESHA
WIJESOORIYA**
CO-SUPERVISOR



K.A.C.H KODITHUWAKKU
IT22544872



N.K.M.PERERA
IT22151810



D.D.M JAYASINGHA
IT22162250



M.P.J.R.DASANAYAKA
IT22152664

Introduction

Small Food Businesses



- Use paper receipts for purchases
- Receipts contain ingredient costs & quantities
- Manual tracking is slow and error-prone

Need for Digital Solution



Scan receipts automatically



Extract ingredient data



Support better cost management

Paper Receipts



Digital Data



Business Insights

Background

Current Situation in SMEs

- Manual bookkeeping
- Paper-based receipts
- Unstructured purchase data



Technology Opportunity



OCR → NLP → Analytics



Smart business decisions

Problem



Challenges in Micro-SMEs

-  **Paper-based** expense tracking
-  **Thermal** receipts fade or get damaged
-  No visibility of real ingredient costs
-  **Profit margins** difficult to calculate

Result

-  Incorrect cost decisions
-  Financial uncertainty

Manual system



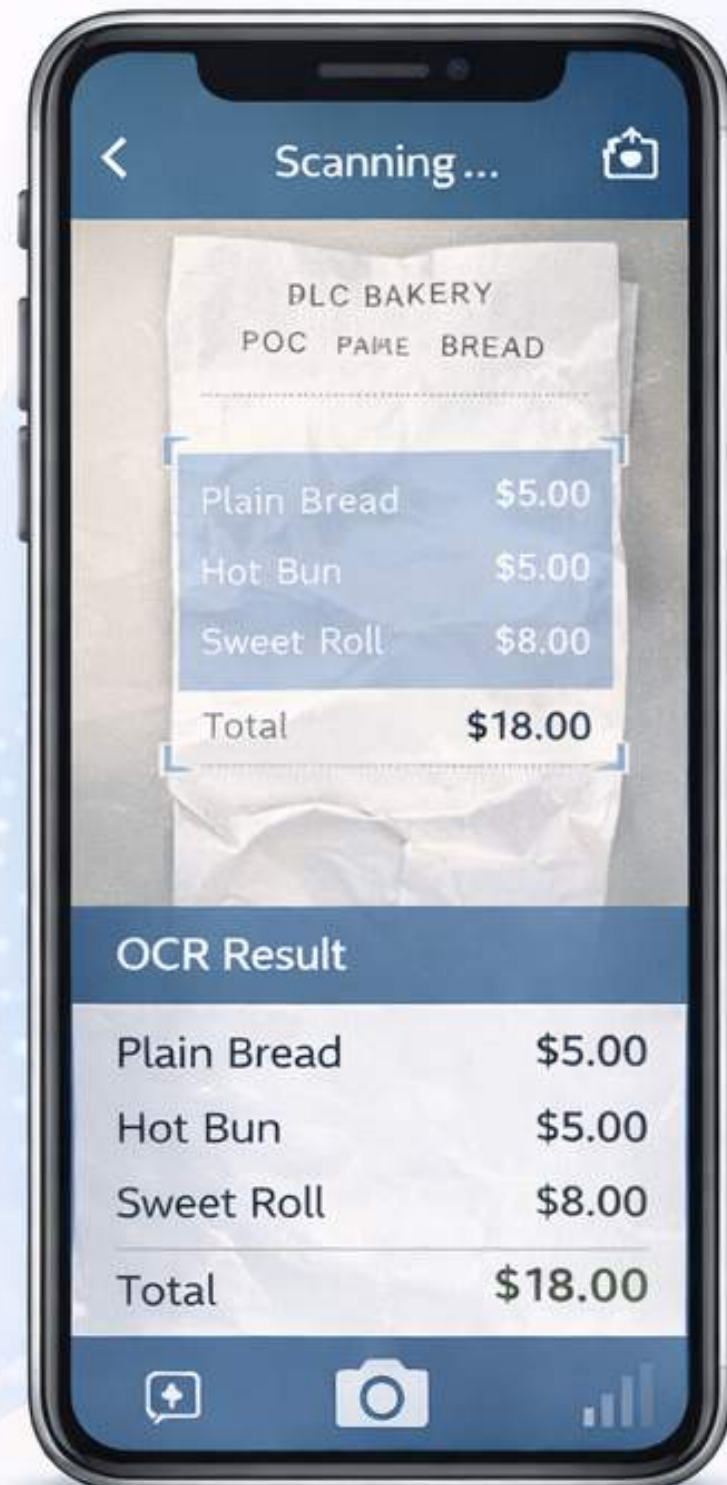
Cost errors



Business risk

Objective

Develop an **Intelligent Decision Support System (IDSS)** for:



Digitizing receipts with OCR & image processing



Analyzing ingredient costs



Calculating real profit margins



Providing mobile insights

Manual system → Cost errors → Business risk

Problem Introduction Video



Users & Stakeholders

Primary Users

These are the main people who directly use the system.

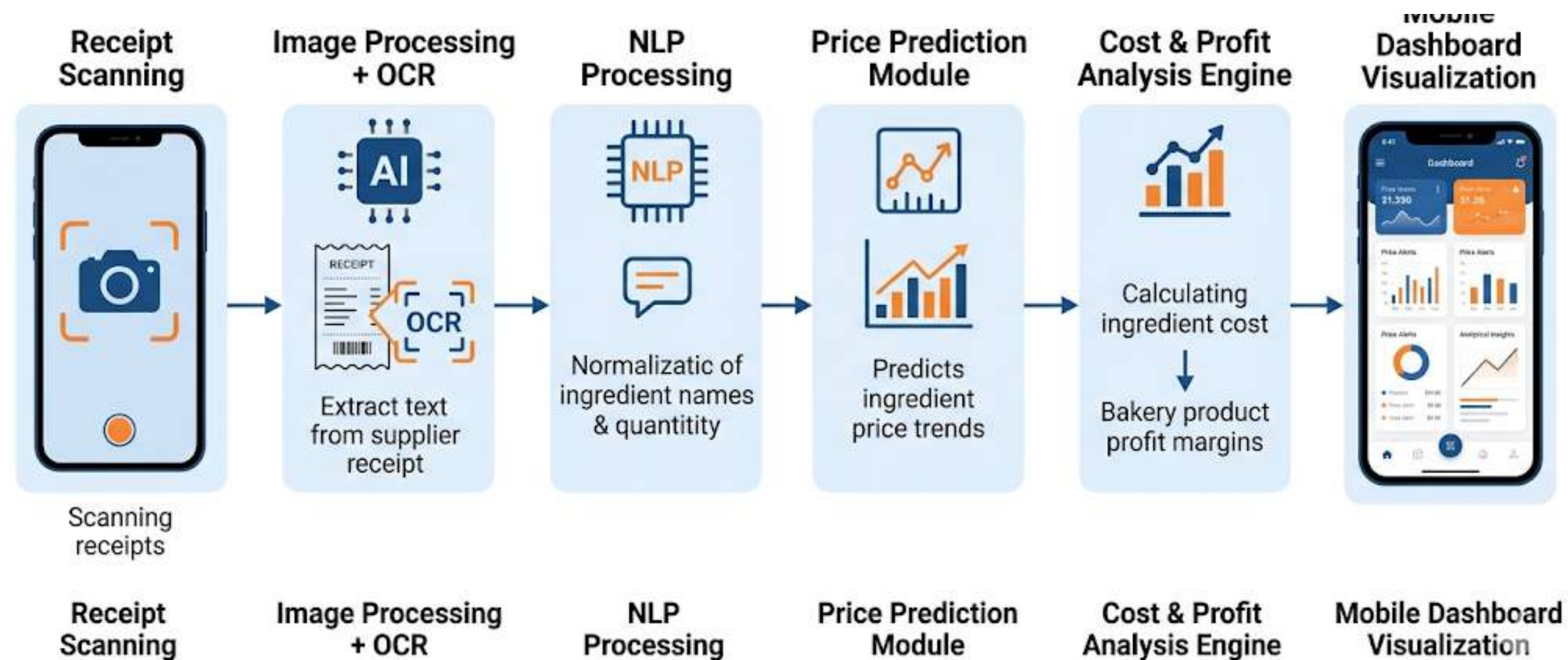
- Small business owners (bakeries, cafés, small restaurants)
- Shop managers
- Business staff responsible for recording purchases and expenses

Stakeholders

- These are people who are indirectly affected by the system.
- Suppliers providing ingredients and materials
- Customers who benefit from better business operations
- Business investors or partners
- Financial advisors or accountants

Methodology

- Receipt Scanning
- OCR Text Extraction
- NLP Ingredient Processing
- Price Prediction
- Cost & Profit Analysis
- Dashboard Visualization



K.A.C.H KODITHUWAKKU
IT22544872

Novelty

Adaptive Thermal Receipt Restoration for
OCR-Based Inventory Digitization



Problem

Thermal receipts are widely used in micro food businesses.

- Receipts become faded or damaged
- Mobile photos create distortion & shadows
- Difficult to digitize receipt data
- Leads to inaccurate cost tracking



Problem Background & Research Problem

Challenges in Digitizing Thermal Receipts from Bakeries and Cafés

Current Situation



Bakeries use **thermal paper receipts** to track purchases



Receipts become **faded, crumpled** or **damaged**



Captured using **mobile cameras**

Degraded Receipt Image



OCR Output (Incorrect)

Milk	-	Rs. 150.00	✗
Butter	-	Rs. 300.00	✗
Sugar	-	Rs. 80.00	✗
Flour	-	Rs. ???	✗

Technical Challenge



OCR struggles with **low contrast & distortion**



Presence of **noise, shadows & blur**



Leads to incorrect **text extraction** & wrong data



Need for an Image Restoration Pipeline to Improve OCR Accuracy



Enhance Quality



Remove Noise



Correct Distortion



Accurate OCR

Objective

Develop a preprocessing pipeline to improve OCR readability

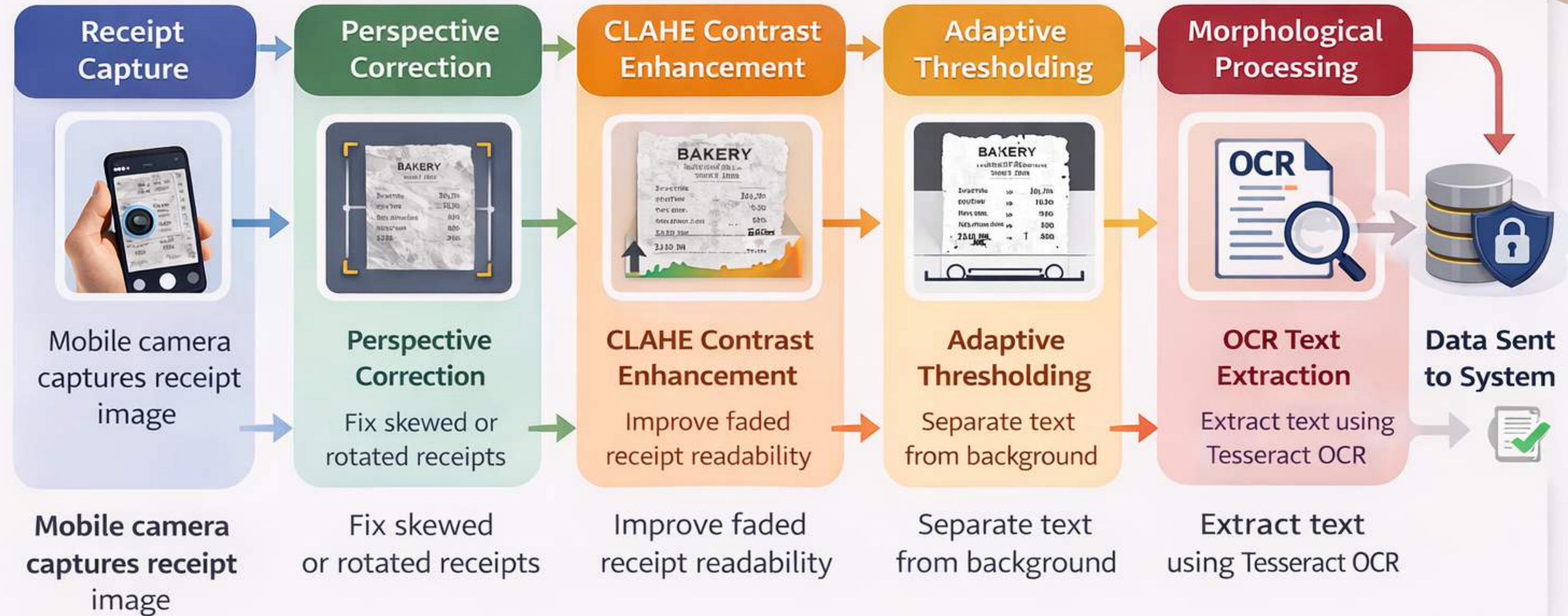
Goal:

- Restore degraded receipt images
- Improve OCR accuracy
- Enable reliable receipt digitization



Methodology – Adaptive Receipt Restoration

Preprocessing Pipeline for Restoring Degraded Receipts



Novelty (Proposed Method)

Adaptive Receipt Restoration Pipeline

Processing stages:

- 1 Perspective Correction
- 2 CLAHE Contrast Enhancement
- 3 Adaptive Thresholding
- 4 Morphological Processing



System Requirements

Functional Requirements



Capture receipt
images



Process degraded
receipts



Extract text
using OCR



Display results
in dashboard

Non-Functional Requirements



Processing time
< 3 seconds



OCR accuracy
> 85%



Mobile-friendly
interface



Secure data
storage

Expected Results & Contribution

Expected outcome:

- Higher OCR accuracy
- Reduced character recognition errors
- Reliable receipt digitization

Research Contribution

- Adaptive receipt restoration pipeline
- Mobile-based receipt scanning system

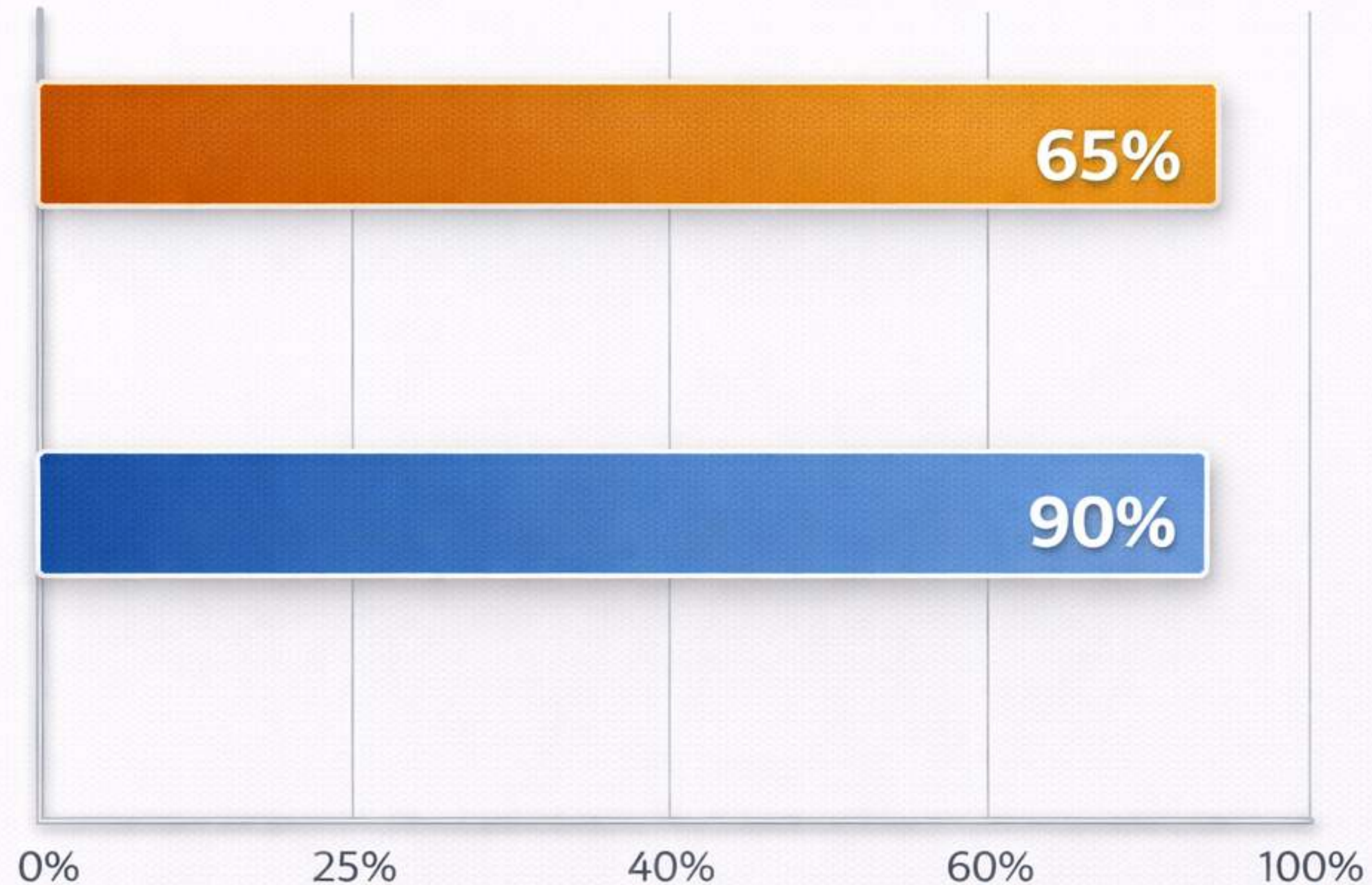
Expected Results & Contribution

OCR Accuracy Improvement

Raw Receipt Image

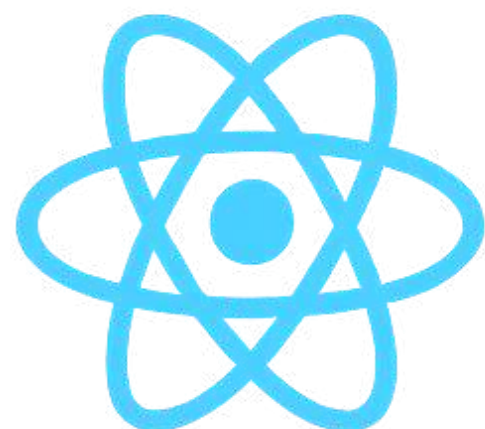


Proposed Pipeline



Higher Accuracy → Reduced Errors

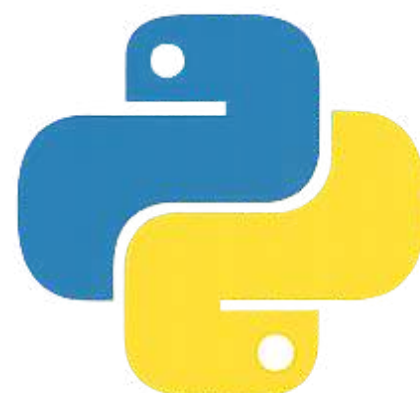
Technologies



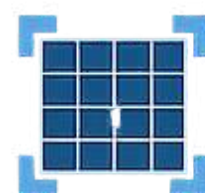
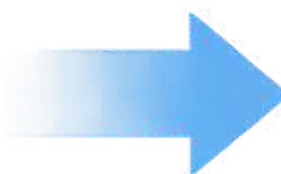
React Native



OpenCV



Python



Tesseract OCR



PERERA N.K.M
IT22151810

Novelty

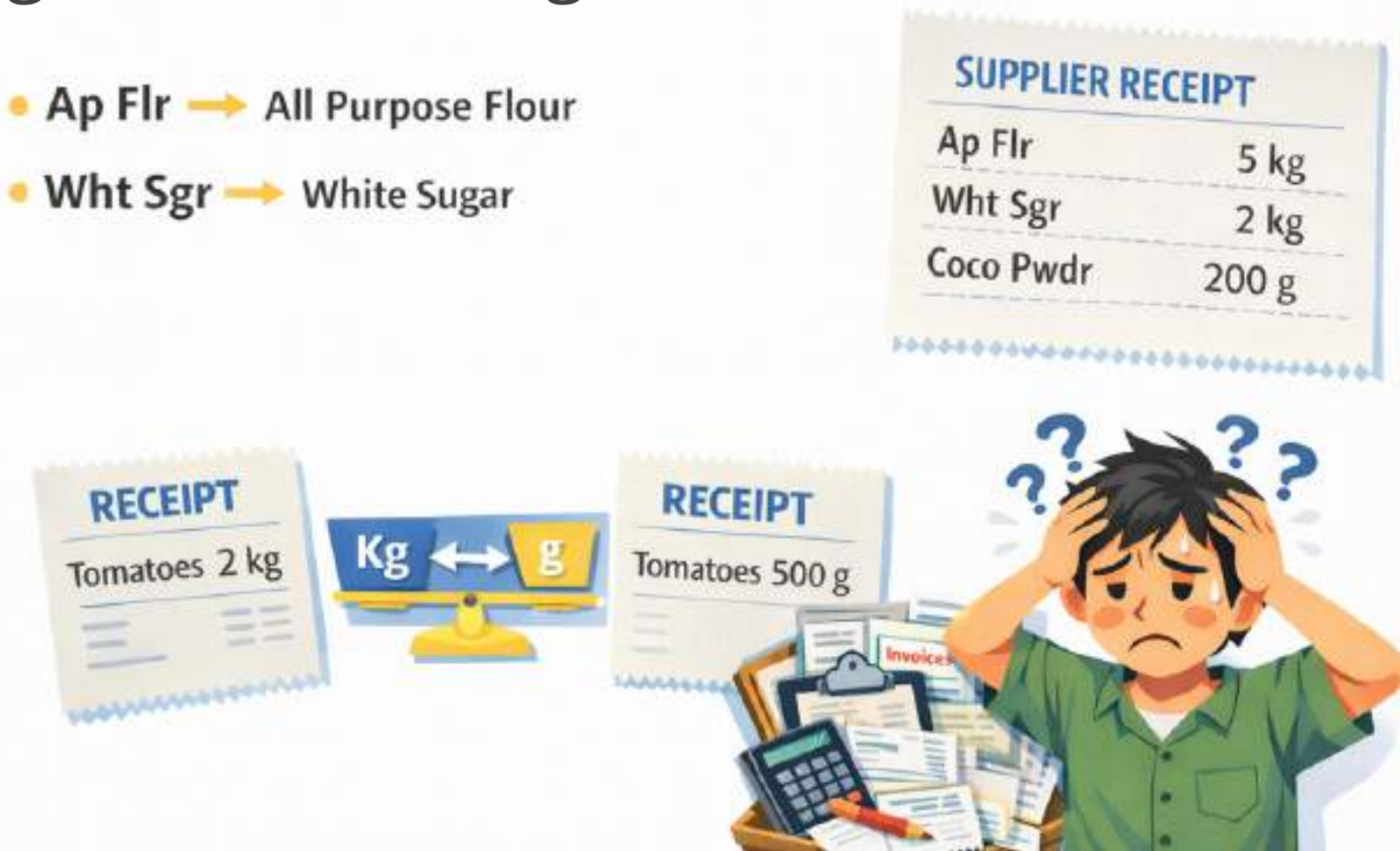
Semantic Inventory Normalization
Engine



Problem

- Manual processing is difficult and time-consuming
- Supplier receipts contain abbreviated and inconsistent ingredient names
- Receipts use different measurement units
- OCR can extract text but cannot understand ingredient meanings

- Ap Flr → All Purpose Flour
- Wht Sgr → White Sugar



Objectives

Main Objective

Develop a Semantic Inventory Normalization Engine to categorize ingredient names and convert receipt text into standardized inventory records.

Specific Objectives

- Create an ingredient dictionary
- Use fuzzy matching to detect ingredient variations
- Extract quantities and measurement units
- Convert units into a standard format
- Store normalized data in a database

Novelty

Semantic Inventory Normalization Engine

Processing Stages:

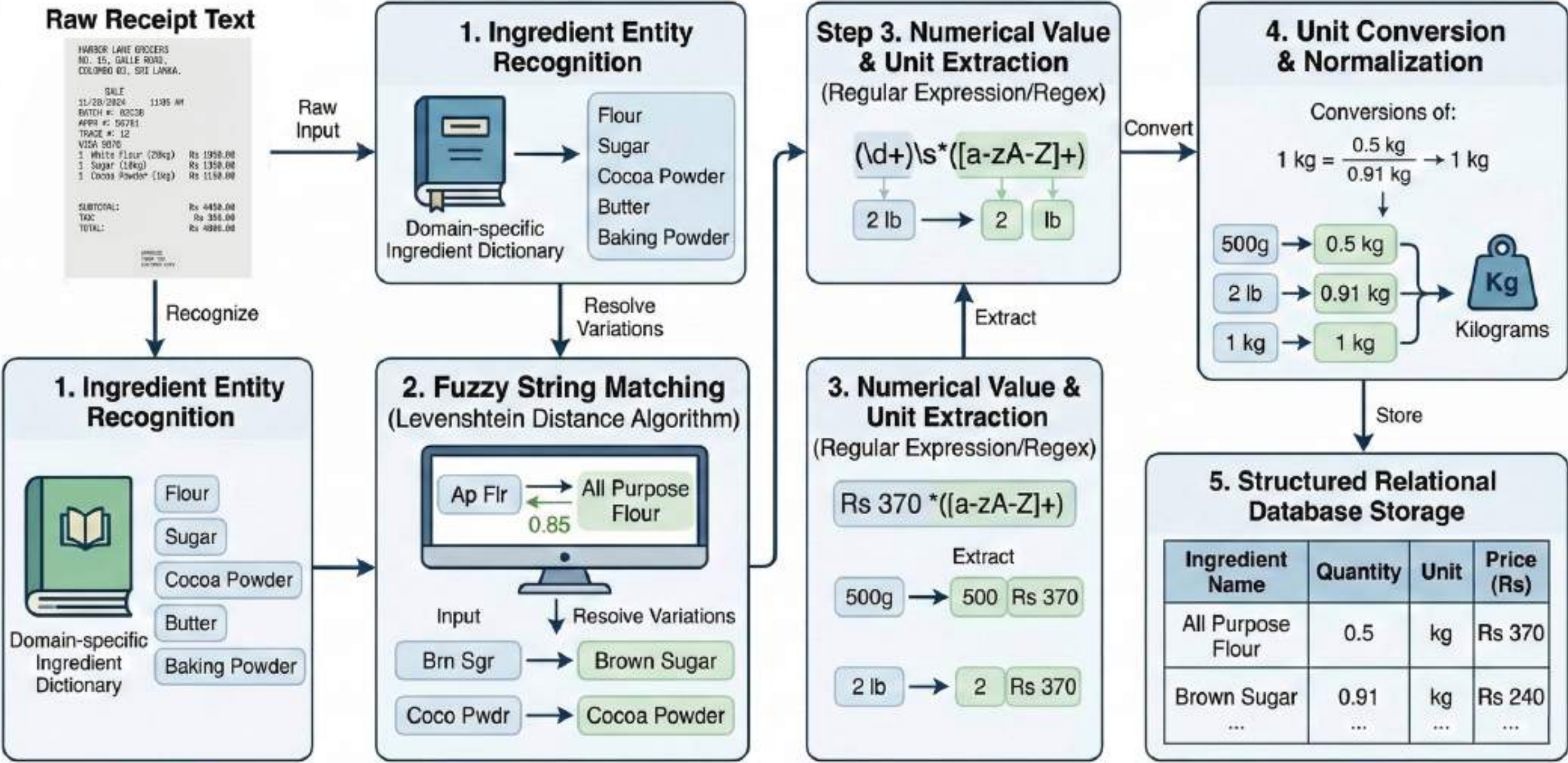
1. Ingredient Name Identification
2. Abbreviation Detection (Fuzzy Matching)
3. Ingredient Categorization
4. Quantity & Unit Extraction
5. Unit Normalization

Methodology

- Literature Review
- Data Collection
- Text Preprocessing
- Ingredient Recognition
- Data Categorization
- Data Normalization

Methodology System Diagram

Technical Data Processing Pipeline for Ingredient Normalization



Functional & Non-Functional Requirements

Functional Requirements

- Receive receipt text from OCR
- Identify ingredient names
- Detect ingredient abbreviations
- Extract quantities and units
- Convert data to standard ingredient records
- Save data in the database

Non-Functional Requirements

- Performance
- Accuracy
- Usability
- Reliability
- Security

Expected Results & Contribution

Expected outcome:

- Identify ingredient names from receipt text
- Recognize ingredient abbreviations
- Extract quantities and measurement units
- Convert receipt data into standardized records

Research Contribution

- Automatic ingredient data processing
- Reduce manual work
- Improve inventory data accuracy
- Support better inventory management

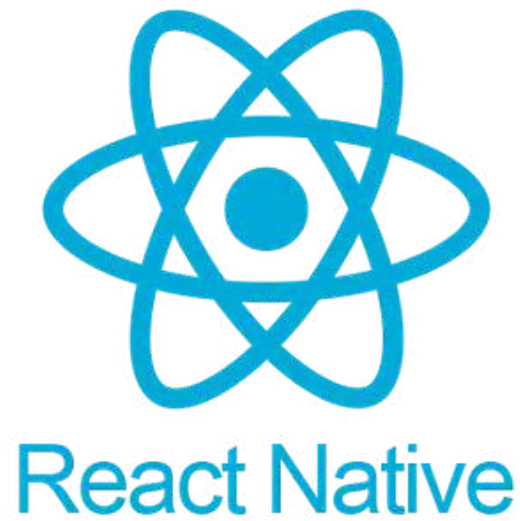


STANDARDIZED INVENTORY RECORDS

ID	Ingredient Name	Qty	Unit	Price (Rs)
1	All Purpose Flour	0.5	kg	Rs 370
2	Brown Sugar	0.91	kg	Rs 240

Structured Ingredient Database

Technologies



D.D.M .JAYASINGHA

IT22162250

Novelty

Hybrid Predictive Supply Chain
Volatility Forecasting



Problem Background

Main Problems Faced by Micro-SMEs

- Bakeries rely on key ingredients (flour, sugar, butter, oil).
- Prices fluctuate frequently.
- Manual price tracking is common.
- Leads to poor purchasing, unstable profits, and inventory issues.
- ERP systems are costly for micro-SMEs.

Micro-SME bakeries cannot predict ingredient price fluctuations, which leads to poor purchasing decisions, unstable profit margins, and inefficient inventory planning.

SMALL BAKERY: RISING COSTS & INVENTORY CHALLENGES



Objectives

Main Objective

Develop a predictive supply chain volatility forecasting module that analyzes historical ingredient prices and predicts future price trends to support micro-SME purchasing decisions.

Specific Objectives

- Collect historical ingredient price datasets.
- Develop forecasting models using ARIMA and Facebook Prophet.
- Identify supply chain volatility patterns in ingredient prices.
- Evaluate forecasting accuracy using MAPE and RMSE metrics.

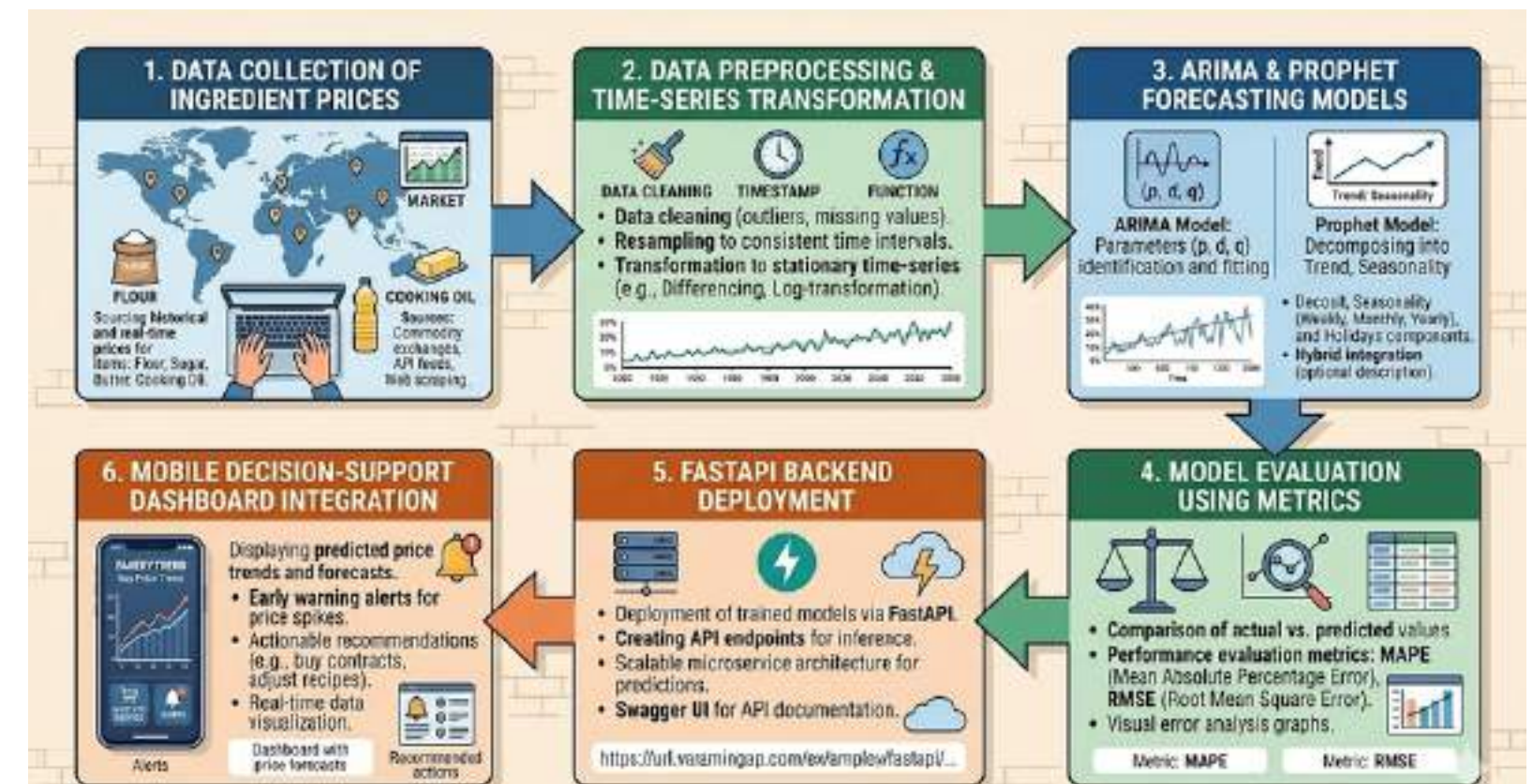
Novelty

- Lightweight predictive system for micro-SMEs
- Uses ARIMA + Prophet for price forecasting
- Confidence interval analysis for volatility detection
- Early alerts for price increases
- Mobile dashboard for decision support



Methodology

- Design Science Research (DSR) methodology
- Collect ingredient price data
- Preprocess & transform time-series data
- Train models: ARIMA + Prophet
- Evaluate using MAPE & RMSE
- Deploy with FastAPI and integrate with mobile system



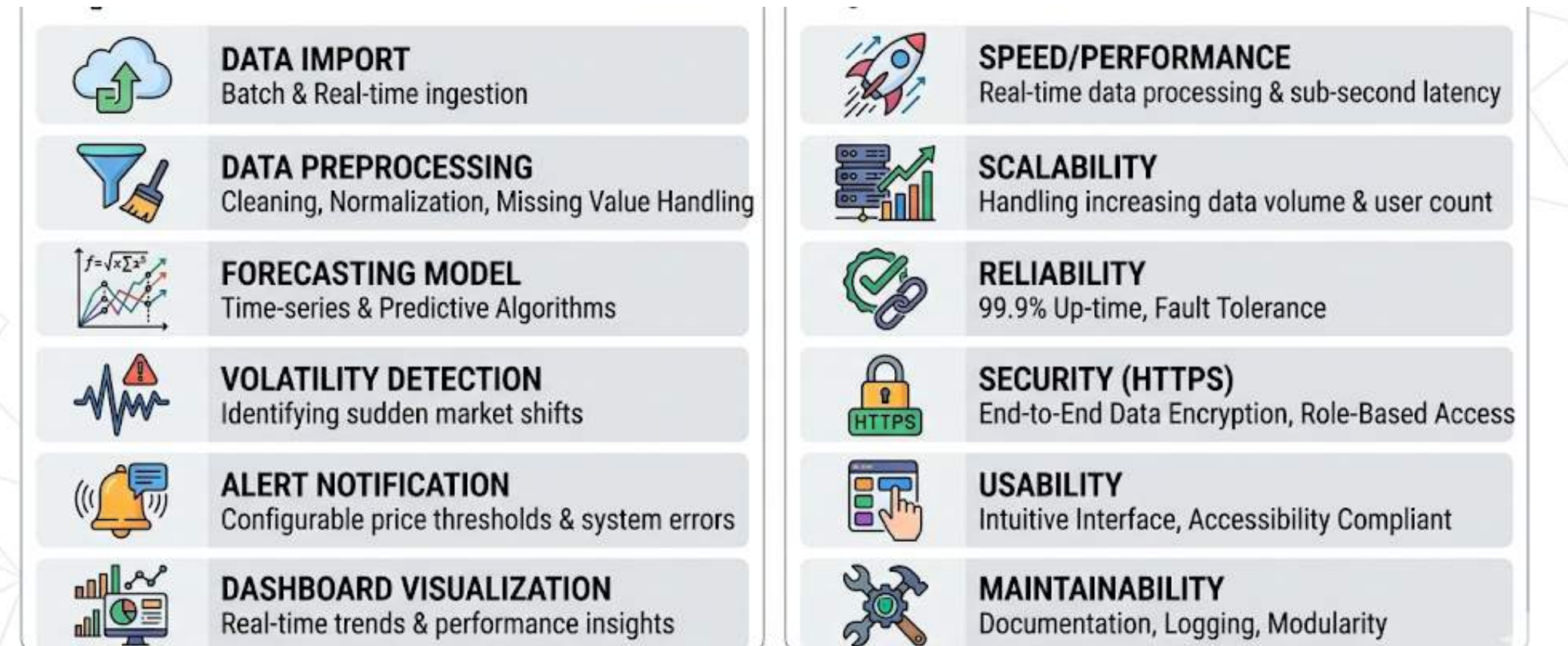
Functional & Non-Functional Requirements

Functional Requirements

- Import ingredient price data
- Preprocess data
- Run price forecasting models
- Detect price volatility
- Generate early alerts
- Display results in dashboard

Non-Functional Requirements

- Fast performance
- Scalable system
- Reliable operation
- Secure API (HTTPS)
- Easy to use
- Maintainable design



Expected Results & Research Contribution

Expected Results

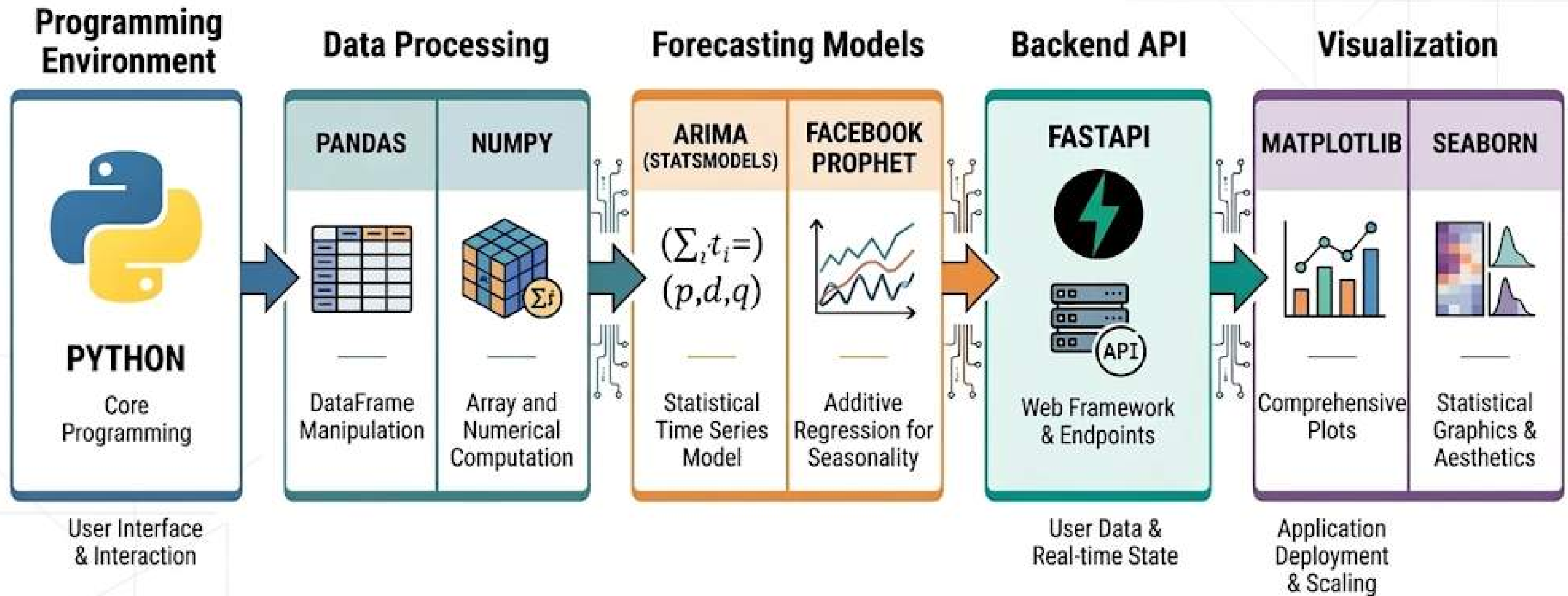
- Accurate ingredient price forecasts
- Detection of price volatility
- Forecast charts of future trends
- Early alerts for price increases
- Supports better purchasing decisions



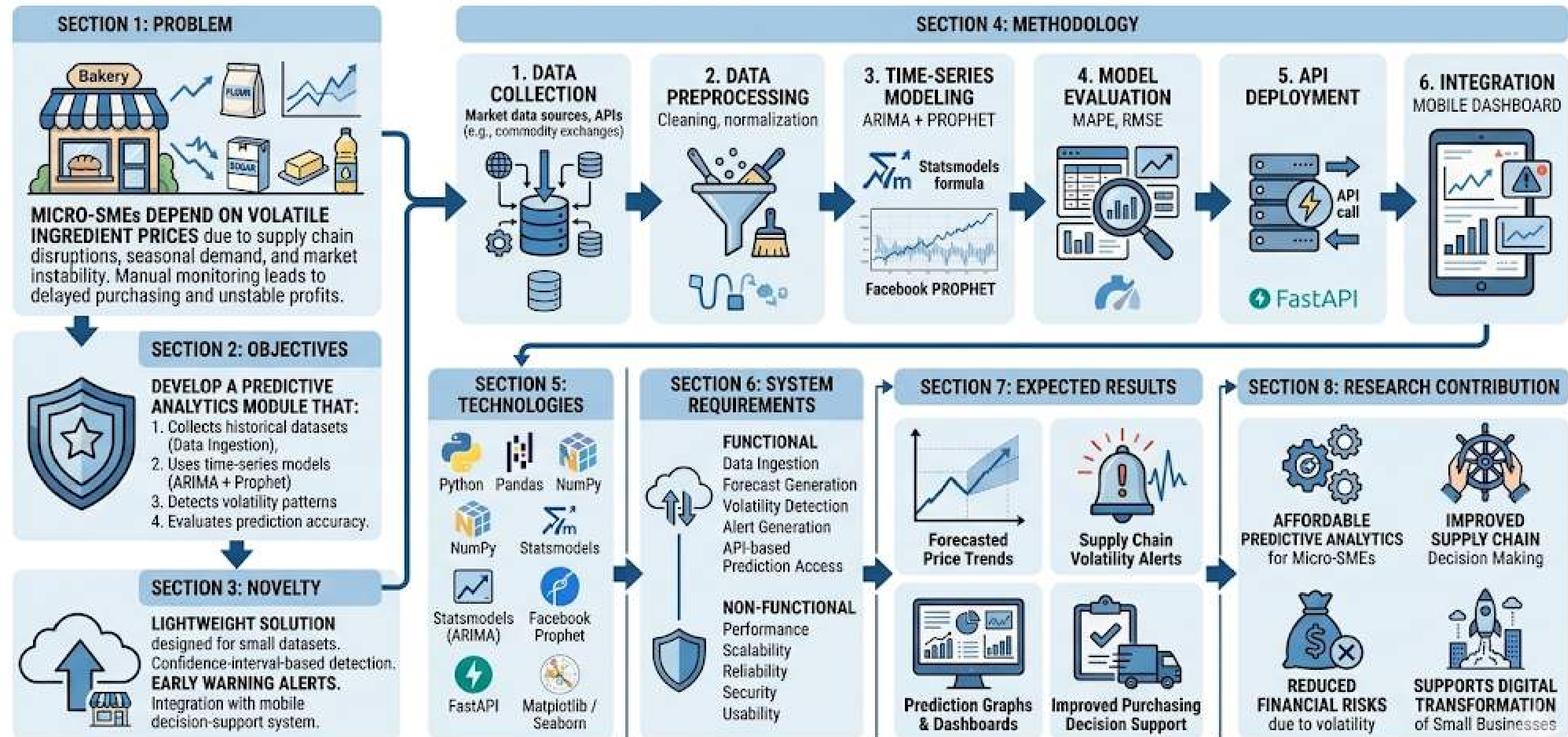
Research Contribution

- Lightweight forecasting system for micro-SMEs
- Apply time-series analytics in small business supply chains
- Improve procurement planning & cost control
- Support digital transformation of SMEs

Technologies



Hybrid Predictive Supply Chain Volatility Forecasting Overview



M. P. J. R. DASANAYAKA

IT22152664

Novelty

Profit Margin Prediction &
Dynamic Threshold Alert System



Problem

- Small businesses record sales using POS systems
- Expense data stored in paper receipts
- Cost and revenue data are separated
- Difficult to monitor real-time profit margins
- Profit decline detected too late

Key Issue

- Lack of intelligent financial monitoring tools for micro-SMEs.

Objectives

Main Objective

Develop a system to predict profit margins and generate alerts when profitability risks occur.

Specific Objectives

- Calculate profit margins
- Analyze financial trends
- Apply dynamic threshold alerts
- Integrate system data
- Visualize results in the dashboard

Novelty

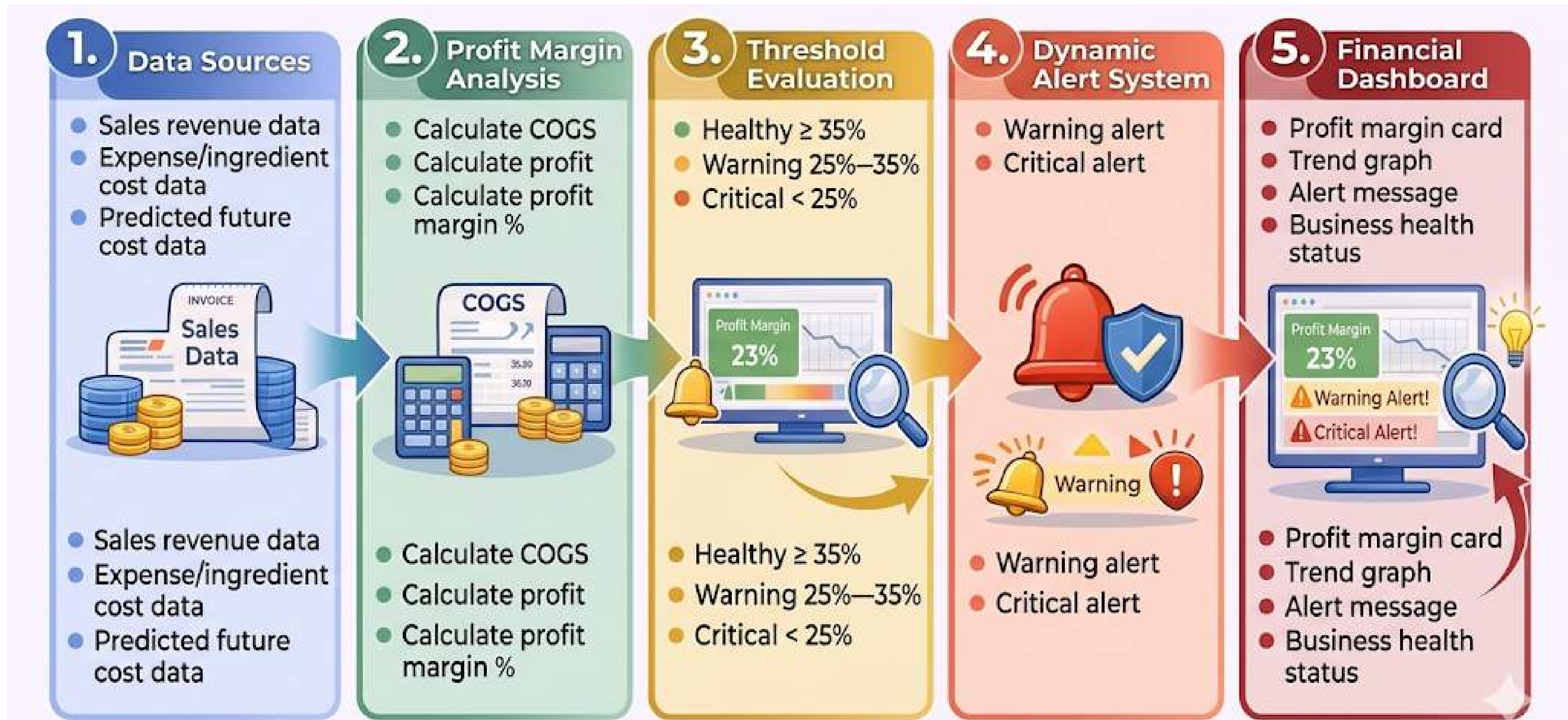
Main Features

- Real-time profit margin calculation
- Integration of revenue and expense data
- Dynamic threshold alert system
- Interactive financial analytics dashboard

Methodology

- Data Sources – Collect sales revenue data and expense data from the SmartCost system to analyze business financial performance.
- Profit Margin Analysis – Calculate Cost of Goods Sold (COGS), profit values, and profit margin percentages using financial analytics methods.
- Prediction Integration – Integrate future ingredient cost predictions from the forecasting module to estimate future profit margins.
- Dynamic Alert System – Monitor profit margin levels and generate warning or critical alerts when profitability falls below predefined thresholds.

Methodology System Diagram



Functional & Non-Functional Requirements

Functional Requirements

- Enter daily sales revenue data
- Integrate expense data from receipt processing modules
- Automatically calculate profit and profit margin
- Generate alerts when profit margin falls below thresholds
- Display financial analytics dashboards and trend graphs

Non-Functional Requirements

- Performance
- Scalability
- Reliability
- Security
- Usability
- Maintainability

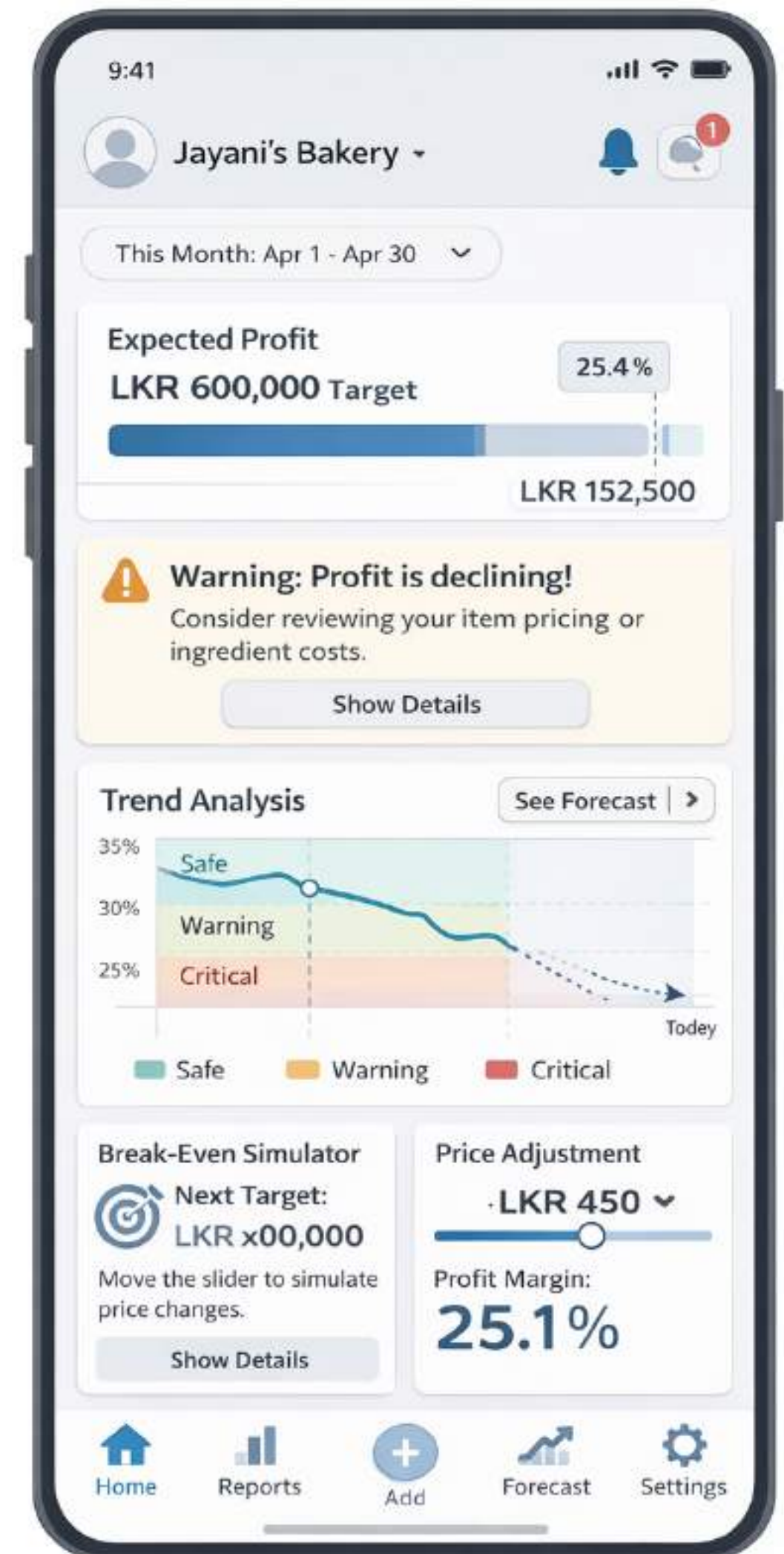
Expected Results & Contribution

Benefits

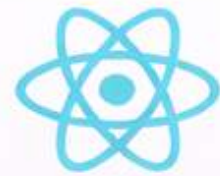
- Real-time profit monitoring
- Early detection of financial risks
- Data-driven business decision support
- Improved financial sustainability for SMEs

Impact

Helps micro-SMEs maintain stable profitability through intelligent financial analytics.



Technologies



React Native

Mobile dashboard development



Python (Pandas, NumPy)

Financial data processing

Pandas • NumPy



Chart Libraries

Data visualization



REST APIs

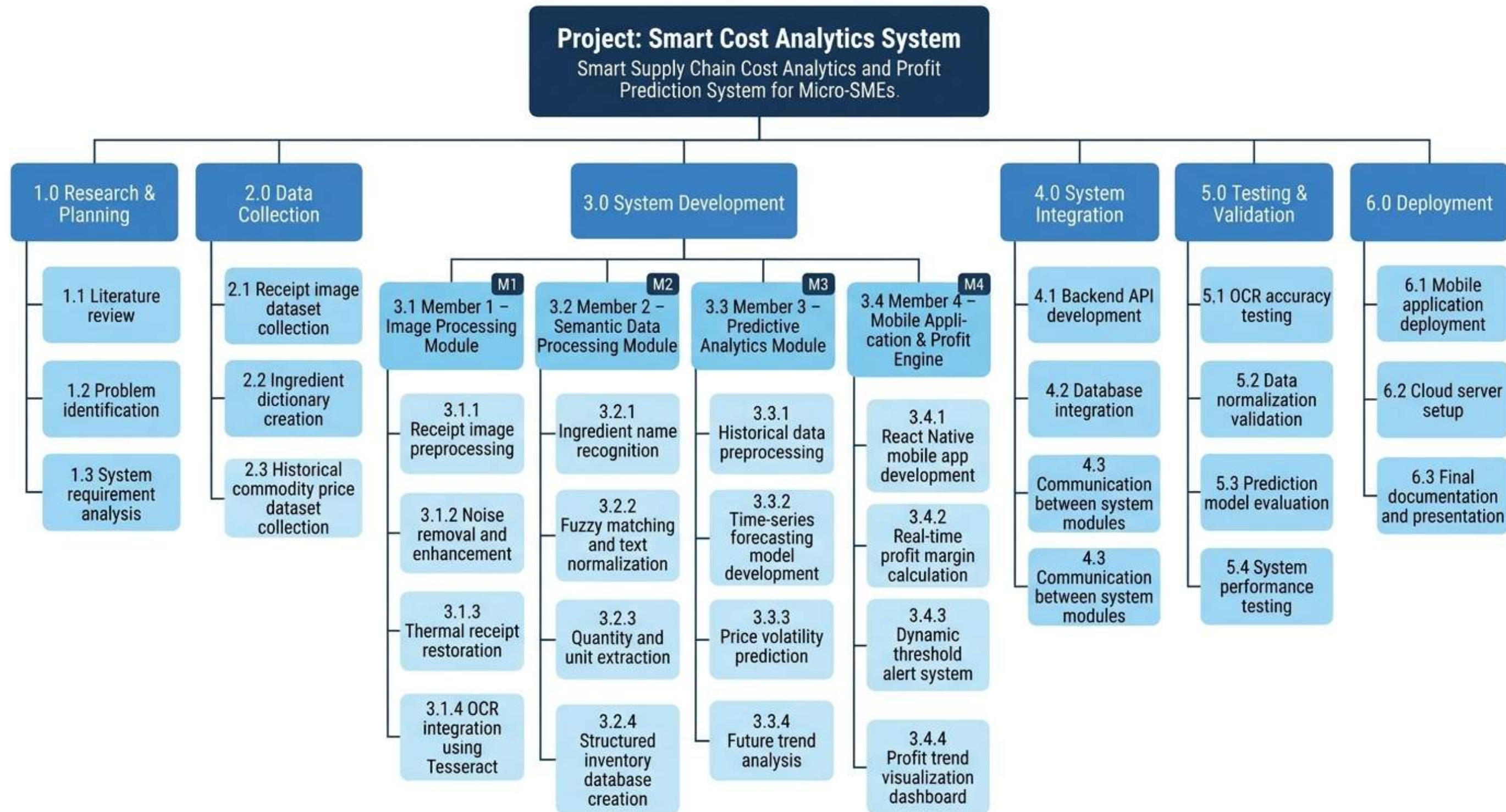
System integration



VS Code & Git

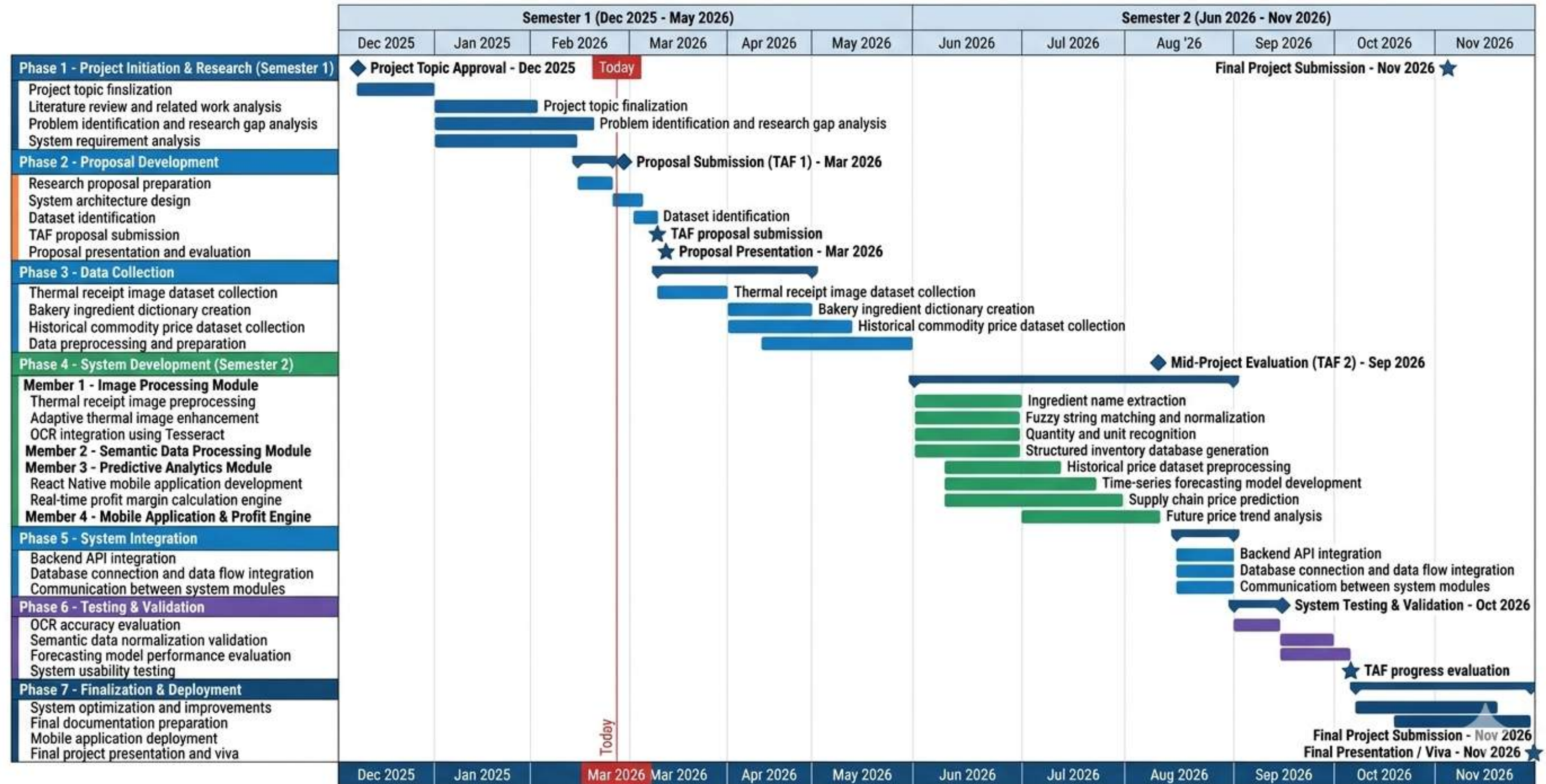
Development tools

Work Breakdown Structure



Gantt Chart

Professional Academic Gant Chart Timeline: Smart Supply Chain Cost Analytics and Profit Prediction System for Micro-SMEs



COMMERCIALISATION PLAN



Bakeries



**Cafés /
Coffee Shops**



**Small Food
Businesses**

Target Customers

Target Customers

- Bakeries
- Cafés / Coffee Shops
- Small food businesses

Approximate businesses:

- Bakeries → 6,500
- Cafés / small restaurants → 4,200

Total potential users

- 10,000+ businesses

Market Opportunity

Subscription price

- LKR 499 / month

Estimated market value

- LKR 60 Million / month



Value Proposition

Customer Problems

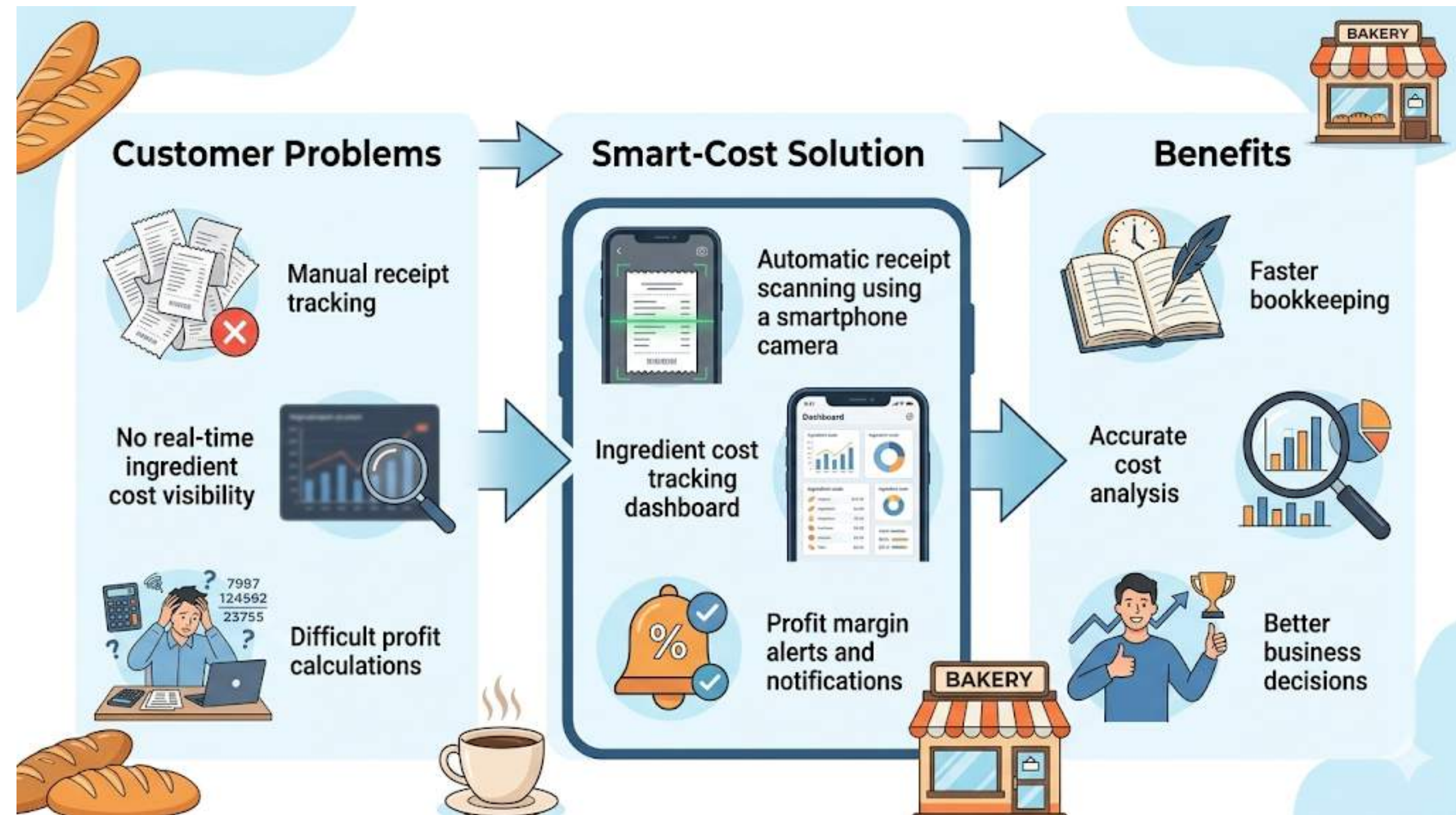
- Manual receipt tracking
- No real-time ingredient cost visibility
- Difficult profit calculations

Smart-Cost Solution

-  Automatic receipt scanning
-  Ingredient cost tracking
-  Profit margin alerts

Benefits

- ✓ Faster bookkeeping
- ✓ Accurate cost analysis
- ✓ Better business decisions



Revenue Model

- Basic receipt scanning → Free
- Advanced analytics → LKR 499/month

REVENUE MODEL: BAKERY COST MANAGEMENT APP

TWO-TIER PRICING

Free Plan



Basic receipt
scanning



Simple receipt
management



Simple receipt
management



Premium Plan

Advanced analytics and insights



LKR 499
per month

Cost Structure

Development Costs

- AI model development
- Mobile application development

Operational Costs

- Cloud hosting
- Data storage
- System maintenance

Marketing Costs

- SME awareness programs
- Business partnerships



Market Strategy

Phase 1 – Pilot (Colombo)

- 50 bakeries
- Free trial for 6 months

Phase 2 – Provincial Expansion

- Bakery associations
- Chamber of Commerce

Phase 3 – Nationwide Growth

- Google Play distribution
- Sinhala / Tamil support



Intellectual Property Strategy

Patent

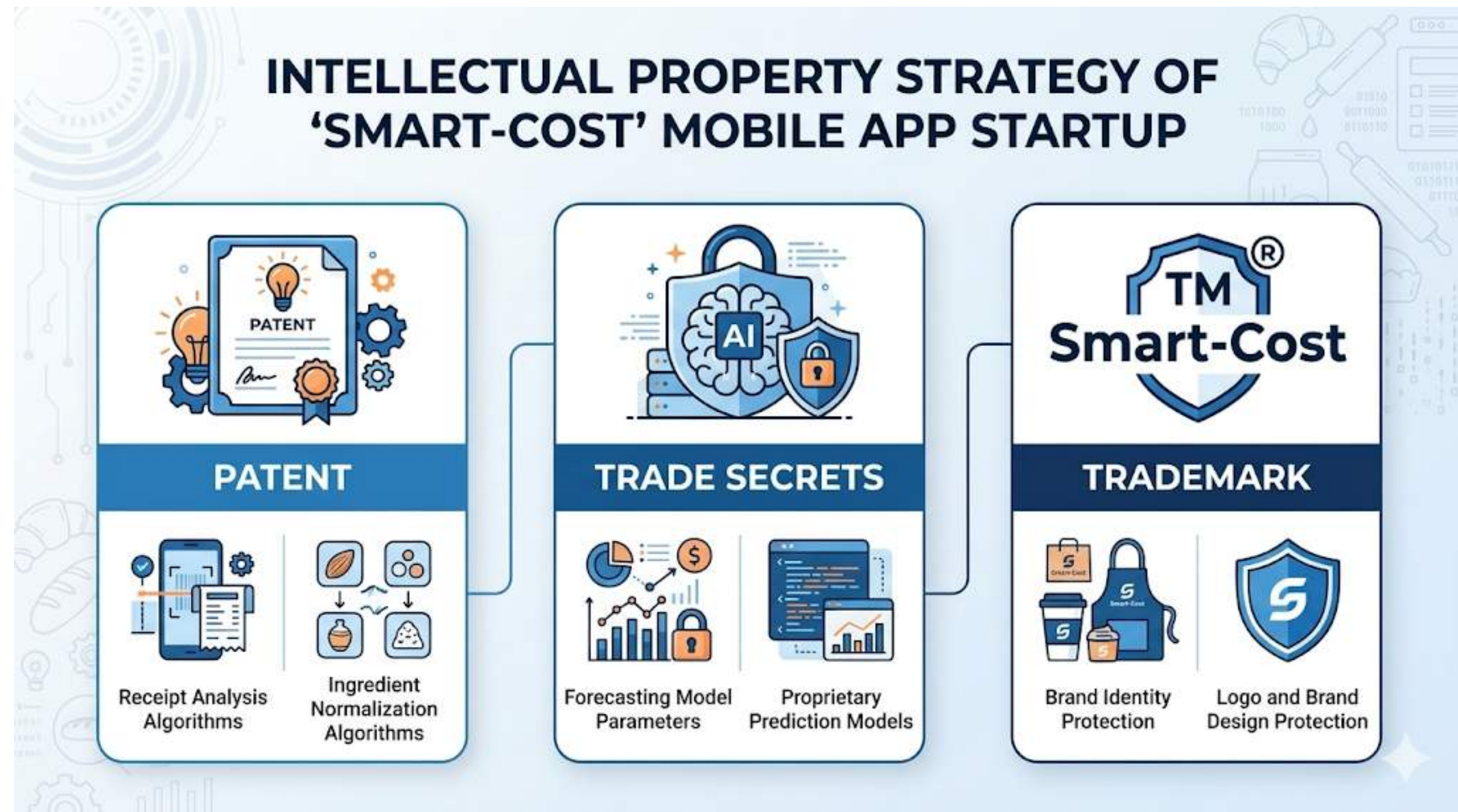
- Receipt analysis & normalization algorithms

Trade Secrets

- Forecasting model parameters

Trademark

- Smart-Cost brand



Competitive Advantage

	Traditional Apps	Smart-Cost
 RECEIPT SCANNING	✓	✓
 COST TRACKING	✗	✓
 PRICE FORECASTING	✗	✓
 PROFIT ALERTS	✗	✓
		★ More Advanced Features

SMART-COST'S COMPETITIVE ADVANTAGE: FEATURE COMPARISON
A GAME-CHANGER IN EXPENSE MANAGEMENT

Risk & Mitigation

Technical Risk

OCR errors

- Solution → Image preprocessing pipeline

Adoption Risk

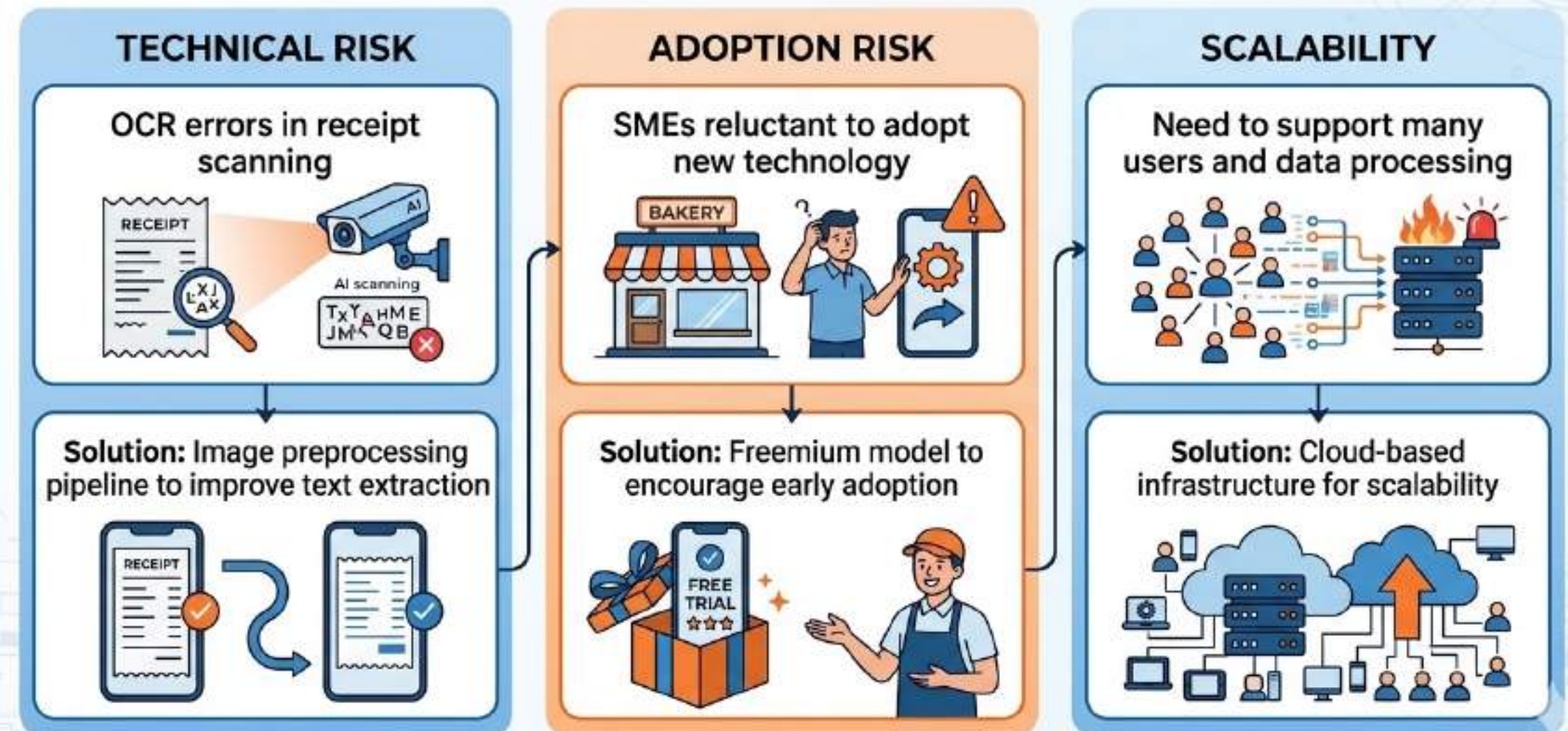
SMEs reluctant to adopt technology

- Solution → Freemium model

Scalability

- Cloud-based infrastructure

RISK AND MITIGATION STRATEGY FOR 'SMART-COST' MOBILE APP



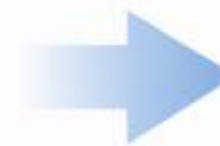
Economic Impact

If 5,000 businesses adopt Smart-Cost



Average Profit Increase

10–18% 



Estimated Economic Value

≈ LKR 1 Billion

SME Financial Benefits in Sri Lanka

R26-IT-026 Ethical Clearance

 **FACULTY OF COMPUTING**
Research Ethics Review Form

All students undertaking research in the Faculty of Computing must fill in and submit this form to the respective coordinator / supervisor as instructed by the program head.

SECTION 1

1. Project/research type

☒ B.Sc. ☐ M.Sc. ☐ MPhil/PhD

2. Project/research details

Project ID (if any)	R26-IT-026
Research Title	Smart-Card : Smart Supply Chain Cost Analytics and Profit Prediction System for Micro-SMEs

3. Student details (if the project is a group project, insert the details of group leader first)

Student ID	Name	Email	Phone
IT2254872	Kodhanakshi K.A.C.H	IT2254872@my.slit.lk	8760352847
IT22151818	Peera N.K.M	IT22151818@my.slit.lk	8765884100
IT22162293	Jayasingha D.D.M	IT22162293@my.slit.lk	8773505132
IT22152664	Dissanayaka M.P.R	IT22152664@my.slit.lk	8712209554

4. Supervisor details

Supervisor Name	Mr. Deemantika Siriwardana
Co-supervisor Name (if any)	Ms. Ayisha Wijesooriya
External supervisor (if any)	

SECTION 2: DATA COLLECTION AND STORAGE

Read the following table before answering the questions.

Data Source	Description	Data Collection Methods
Primary Data	Primary data collection happens when researchers obtain information directly from the original sources.	Survey/ Interviews/ Observation/ Focus groups/ New Images etc.
Secondary Data	Data sets already gathered from previous research. This data is usually already analysed and put into context. Sources of secondary data can include:	Books / Past research papers/ Annual reports/ Newspapers / Reports / Websites/ Online Databases etc.

Page 01

Provide details of all data required for your project. (Indicate what data will be required for each component, where the data is available, and how you plan to collect that data.)

Research Component	Data required (e.g. images of leaves)	Amount of Data Required	Data Source (Primary/Secondary)	Collection Method
Machine Thermal Band of Radiation for CO2 Based Inventory Distributions	Thermal receipt images from various supermarkets and small food businesses	100-500 receipt images (date, label, date/time)	Primary Data	Direct collection from shops, mobile camera capture
General Inventory Information (prices)	Ingredient names, international currencies, and measurement units from receipts	100-500 receipt images (date, label, date/time)	Primary - Secondary Data	Extracted from collected receipts, transcription (manual)
Hybrid Predictive Supply Chain Inventory Forecasting	Historical ingredient price data (from super, on, online etc.)	3-5 years historical price records	Secondary Data	Government websites, Super Market, online databases
Profit Margin Prediction System (hybrid - threshold rule system)	Serialized sales transactions and department purchase records	200-500 (realized business transactions)	Primary Data	Serialized form, request and manual data entry

5. DATA COLLECTION: If you require primary data, do you intend to collect data from following groups?

☐ Children or young people
☐ Pregnant women
☐ Individuals with cognitive disabilities
☐ People suffering from specific diseases
☐ Animals
☒ Certain group of people involved in an organization

6. DATA COLLECTION: If you are collecting information related to people, in what form will be the data collected?

☒ Individually identifiable	Data can directly lead to the identification of an individual or organization
☒ Re-identifiable*	Data indirectly leads to the identification of a person or organization (even through direct identifiers are removed)
☐ Non-identifiable	Data does not lead to the identification of a specific individual

*Anonymized data from which the individual could be de-anonymized

7. DATA COLLECTION: Does your project possibly cause/involve any of the following?

☐ Physical stress/distress, or discomfort to participants
☐ Psychological/mental stress/distress, or discomfort to participants
☒ Collection of sensitive/confidential data of individuals
☒ Collection of confidential data of organizations
☐ Development of a product harmful for a particular group or society

Page 02

8. DATA COLLECTION: Explain the procedures you will be following to ensure privacy of participants or organizations during data collection, data analysis and publishing of results.

☒ Before the data collection, participants will be given an information sheet to create awareness
☒ Data will be collected only from the participants who have given consent through a consent form
☒ Personally identifiable data will not be collected
☒ If identifiable data is present in the data set, data will be either anonymized or coded

Additional Measures:
The research will primarily collect receipt images and publicly available price datasets, which do not contain personal information. If any business-related information appears on receipts (such as shop names or addresses), it will be removed or anonymized during preprocessing. All collected data will be used strictly for academic research purposes.

9. DATA STORAGE: If you are collecting information related to people, in what form will the data be stored?

☐ Individually identifiable ☐ Re-identifiable ☒ Non-identifiable

10. DATA STORAGE: Where will data be stored and what measures will be taken to ensure security of data?

☐ Paper-based data stored in locked filing cabinets within SLIIT.
☒ Data stored in hard-drives and computers will be protected by password and encryption.
☒ Data will be anonymized and will not be re-identifiable
☐ After the completion of the project, all data will be permanently deleted from all student devices. Only a single copy will be securely stored within a repository in the institution.

Additional measures:
All research data including receipt images, datasets, and experimental results will be securely stored in password-protected computers and cloud storage. Access to the data will be limited only to the research team members and supervisors. The datasets will be anonymized and used strictly for academic research purposes.

11. How would you rate the overall risk associated with the research? (These risks may occur when the collected data is exposed to unauthorized parties, etc.)

☐ High Risk ☒ Low Risk ☐ Negligible Risk

Page 03

12. Declaration of the participants.

I/we certify that the details given above are accurate and agree to adhere to the conditions of approval specified by the panel. Furthermore, I/we will inform the FoC Research Project coordinator of any deviations from the specified details.

Student ID	Name	Signature
IT2254872	Kodhanakshi K.A.C.H	
IT22151818	Peera N.K.M	
IT22162293	Jayasingha D.D.M	
IT22152664	Dissanayaka M.P.R	

13. Approval of the Supervisor

Supervisor Recommendation (please select one option)

☐ Ethics committee Approval NOT Required
☐ Ethics committee Approval Required

If approval required, clearly specify the reasons:

Supervisor Name	Supervisor Signature	Date

**** Please note that if the supervisor has recommended that ethics committee approval required, student should fill the "Ethics Review Form" of the SLIIT ERC and submit it to the faculty Ethics Sub-committee.**

Page 04

Conclusion

- This research introduces an AI-based system to help Micro-SMEs manage ingredient costs and profits.
- The system digitizes receipts, organizes data, and predicts price changes automatically.
- It helps business owners make better financial decisions and improve profitability.
- The solution has strong potential for real-world adoption in small businesses.

Thank You

