Transport and Telecommunication Institute & UWE Bristol

Artificial Intelligence Group Project

AI-Driven Optimization of OTC Medicine Vending Machines in Latvia

Project proposal

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INTRODUCTION

Access to over the counter (OTC) medicines in Latvia is limited, especially in rural areas where pharmacies typically close between 6 to 8 pm, and only 9 provide 24/7 service. Consequently, rural residents often cannot access essential nonprescription medicines at night or during emergencies.

To improve accessibility and equity in healthcare, this project proposes an artificial intelligence (AI) based system for planning and managing OTC medicine vending machines (OTC-VMs). The system will identify optimal locations, select suitable medicines, and monitor stock and maintenance while ensuring safety, compliance, and responsible use.

1. INITIAL RESEARCH AND RELATED WORK

1.1. Context and Existing Work

OTC-VMs provide access to common medicines such as pain relievers, indigestion remedies, and basic first aid items. They improve convenience by dispensing medicines outside regular pharmacy hours and locations. However, concerns remain about their limited range, lack of pharmacist advice, and risks of unsupervised use. Clear licensing and regulatory frameworks are essential for safe operation and compliance (Merks *et al.*, 2024; Religioni *et al.*, 2024).

1.2. Relevant Literature and Technologies

- **Optimization of facility location:** The Maximal Covering Location Problem (Daskin, 2013) is used in emergency and healthcare planning.
- **Demand forecasting:** ARIMA, XGBoost, and Croston models estimate future demand.
- **Predictive maintenance:** Machine learning predicts equipment failures in IoT systems.
- **Conversational AI:** Rule-based chatbots provide safe OTC guidance with disclaimers and symptom checks (Ramadhani, 2023; Ben-Shabat *et al.*, 2022; WHO, 2023).
- **Agile data-science frameworks:** Data-Driven Scrum (Data Science-PM, 2025) integrates the scientific method with agile practice.

1.3. Existing Products

Existing pharmacy vending systems dispense OTC medicines and self-testing kits in airports, hospitals, universities, and shopping centers. Operational models exist in the USA, Canada, Germany, Japan, and the UAE, some with remote pharmacist support or digital authentication (Jairoun *et al.*, 2024). Bulgaria has introduced similar machines in small towns as pharmacy substitutes, marking early adoption within the EU (Euractiv, 2024).

2. PROJECT OBJECTIVES AND SCOPE

2.1. Objectives

- **Accessibility:** Assess population distribution and accessibility gaps across regions to recommend optimal OTC-VMs locations.
- **Safety and Compliance**: Restrict sales to approved OTC categories, separate adult and child products, and limit "1 package per medicine group per 24 hours."
- **Efficiency**: Forecast demand, rack stock and expiry, and schedule refills.
- **User Guidance**: Develop an AI chatbot to suggest suitable OTC categories based on symptoms while displaying safety disclaimers.
- **Monitoring and Maintenance**: Implement dashboards for stock control and predictive maintenance of OTC-VMs.

2.2 In Scope

- **Data Collection:** Open data statistics and registries.
- **Model Development:** Placement and demand forecasting.
- **Prototype:** Web dashboard and chatbot interface.
- **Maintenance:** Predictive maintenance simulation.
- **Compliance:** Ethical, legal, and privacy review.

2.3 Out of Scope

- **Prescription Medicines:** Excludes all prescription-only products.
- **System Integration:** No connection to live payment or pharmacy databases.
- **Hardware Deployment:** Does not include installation of physical OTC-VMs.
- **Medical Functions:** No diagnostic or treatment capabilities.

3. PROPOSED WORK PACKAGES AND TASKS

Table 1. Summary of Work Packages and Lead Roles

WP	Title	Main Tasks	Lead Role
WP1	Domain Analysis & Ethics	Research OTC regulations, define medicine groups, purchase rules, success metrics.	Product & Domain Lead *(Sanita)*
WP2	Data collection & Engineering	Gather population, pharmacy, and medicine data; create unified database; clean and preprocess.	Data Engineer *(Vita)*

WP3	AI Modelling & Optimization	Build models for location optimization, demand forecasting, and refill prediction.	Data Scientist *(Mostafa)*
WP4	App & Chatbot Development	Create a web app with interactive map, inventory dashboard, bilingual chatbot.	App & Chatbot Developer *(Toufic)*
WP5	Visualization & Predictive Maintenance	Build dashboards for stock and expiry alerts; develop machine-failure prediction models.	Monitoring Engineer *(Joanss)*
WP6	Integration & Testing	Combine modules, validate KPIs, prepare demo and final report.	All Team Members

4. PROJECT MANAGEMENT METHODOLOGY

The team will apply **Data-Driven Scrum (DDS)**, an agile framework tailored for data-science projects. Key adaptations:

- **Iterations:** Each iteration focuses on a *data experiment* or hypothesis rather than a time boxed sprint.
- **Cycle:** Every backlog item passes through ***Create → Observe → Analyse***, ensuring measurable outcomes.
- **Backlog Prioritisation:** Items are evaluated by *value*, *effort*, and *probability of success* before selection.
- **Meetings:** Weekly stand-ups for progress; iteration reviews to present data results; retrospectives every two weeks to improve workflow.
- **Board:** A shared online board tracks items across ***Create → Observe → Analyse***, stages with WIP limits.
- **Metrics:** Accessibility %, forecast error (MAPE), stockout rate, expiry waste, chatbot accuracy, and uptime serve as sprint KPIs.

5. IMPLEMENTATION PLAN AND TIMELINE

Table 2. Weekly Project Schedule and Deliverables

Week	Main Activities	Deliverables
1	Define scope, literature, set up DDS board, data sourcing.	Project proposal, initial datasets.
2	Complete data cleaning and integration; exploratory analysis.	Clean data repository, baseline stats.
3	Develop and test placement optimization model.	Coverage map, accessibility metrics.
4	Implement demand forecasting and stock/expiry prediction; begin chatbot prototype.	Model results, chatbot MVP.

5	Add monitoring dashboard and predictive-maintenance module.	Visual dashboard, maintenance alerts.
6	Integrate components, evaluate metrics, finalize report & presentation.	Complete system prototype.

(An extended Gantt chart - https://docs.google.com/spreadsheets/d/1DDU8utSqy8xt4zrd4ERUqbRw_ayh9XI5/edit?usp=drive_link&ouid=111780478978484792133&rtpof=true&sd=true)

6. RISKS AND MITIGATION (SUMMARY)

Table 3. Project Risks, Impact, and Mitigation Strategies

Risk	Impact	Mitigation Strategy
Limited or incomplete public data	Medium	Use synthetic / simulated data aligned with known statistics.
Regulatory restrictions on OTC sales	High	Strictly adhere to the official Latvian OTC list; legal review.
Forecast model under-performance	Medium	Iterate with multiple algorithms and cross-validation.
Overlapping tasks or coordination delays	Medium	Weekly DDS review meetings and shared board updates.
Time constraints near deadline	High	Prioritise core deliverables (placement + forecasting) before advanced features.

7. EXPECTED OUTCOMES

- **Distribution Map:** Interactive map showing optimal vending machine locations across Latvia.
- **AI Models:** Predict demand, stock refill needs, and maintenance schedules.
- **Chatbot Prototype:** Safe, bilingual chatbot providing OTC symptom guidance.
- **Dashboard:** Visualises stock levels, expiry dates, and key performance metrics.
- **Impact Evidence:** Demonstrates that data-driven planning can improve healthcare accessibility and reduce waste.

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