AI-Powered Dashboard for Cohort Study Monitoring and Analysis

PLRI
PETER L. REICHERTZ INSTITUTE FOR MEDICAL INFORMATICS

Hamidreza Maharlou, Steffen Oeltze-Jafra

Peter L. Reichertz Institute for Medical Informatics, Hannover Medical School

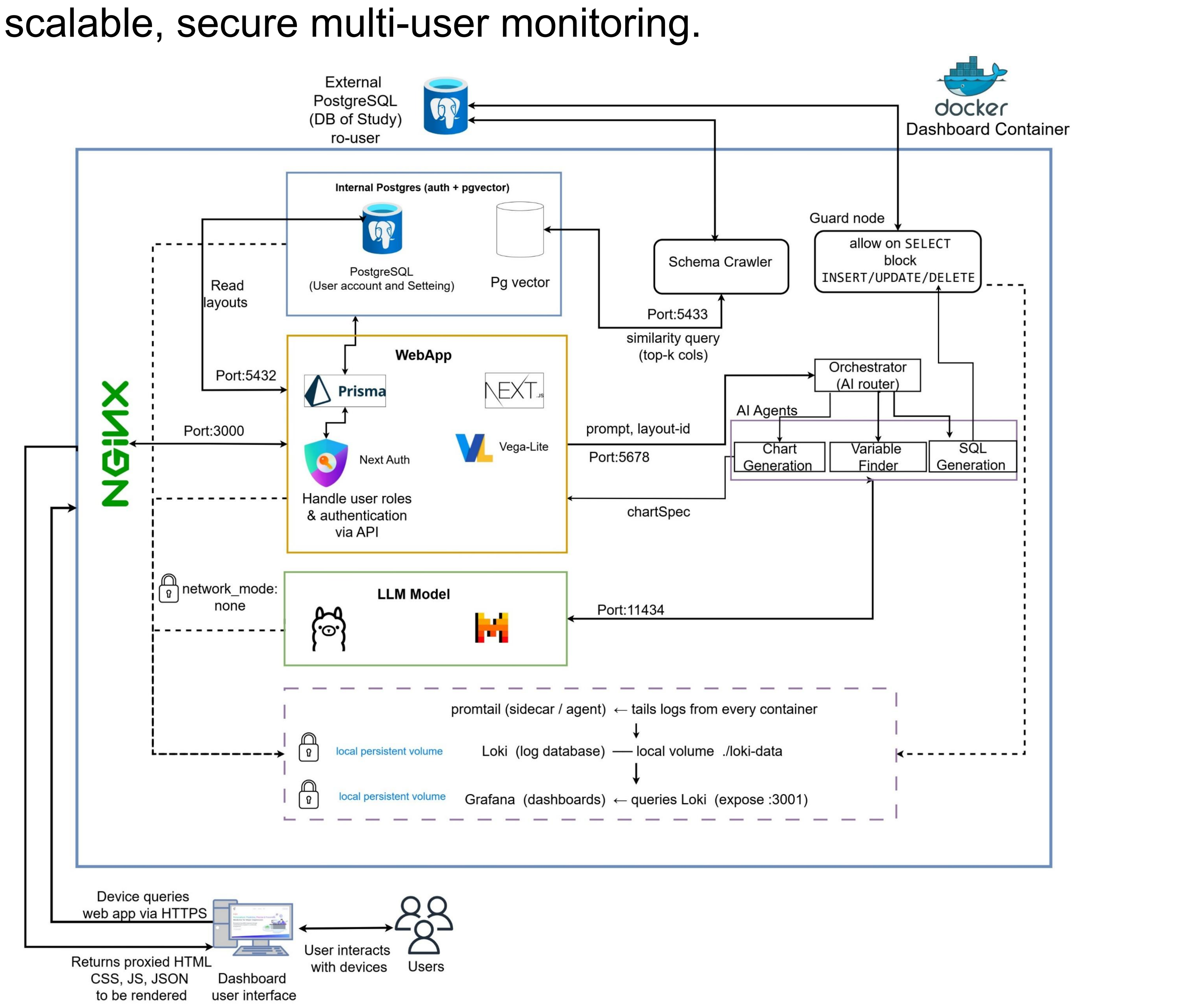
1 Motivation

Large-scale cohort studies produce heterogeneous and high-volume data across multiple sites. Detecting missing assessments, protocol deviations, or anomalies is time-consuming and usually requires technical expertise. Existing dashboards are often static and inflexible, limiting their use for clinicians and study coordinators.

To address these challenges, we present **CohortCanvas**, an AI-powered dashboard that combines natural-language interaction with modular agent-based architecture. CohortCanvas lowers technical barriers, enables real-time study monitoring, and supports flexible post-study analysis through automated chart generation. Our goals are to improve accessibility, reliability, and scalability while ensuring secure deployment across multi-site studies.

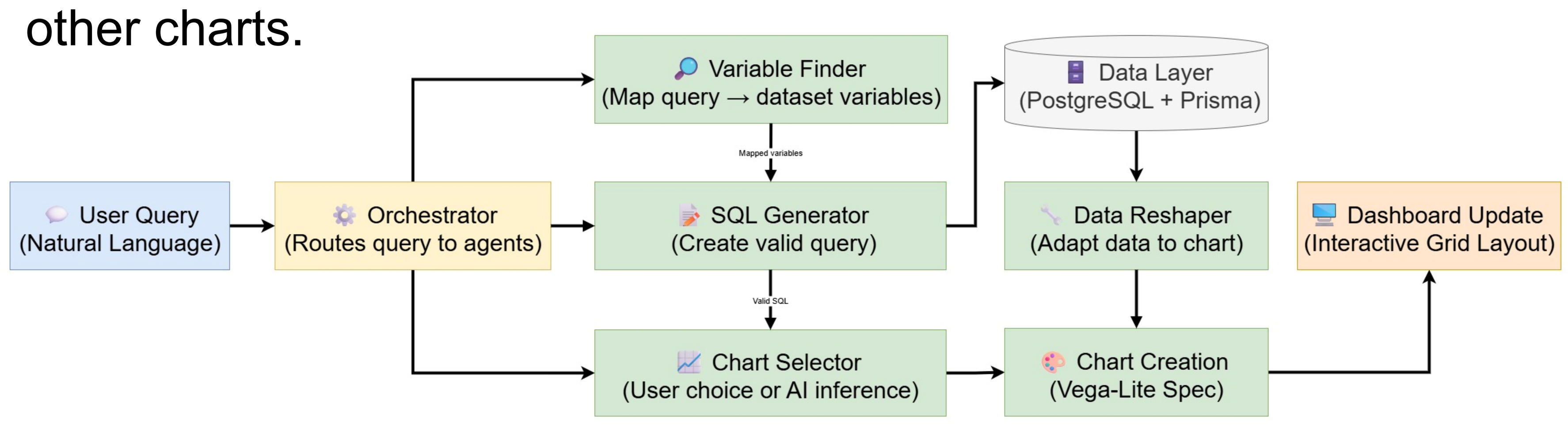
2 System Design

- **Interface (WebApp, NextAuth, Vega-Lite, Prisma):** Handles user roles, authentication, and chart rendering.
- **Orchestrator (AI Router):** Directs user queries to specialized AI agents.
- **AI Agents:**
  - *Semantic Variable Finder* — maps natural language to dataset variables.
  - *SQL & Chart Generator* — produces valid SQL and Vega-Lite visualizations.
- **Schema Crawler:** Extracts DB schema and column metadata to support variable matching and safe query generation.
- **Guard Node:** Enforces read-only SQL before execution.
- **Backend & Deployment:** PostgreSQL, Docker, Loki/Grafana for scalable, secure multi-user monitoring.

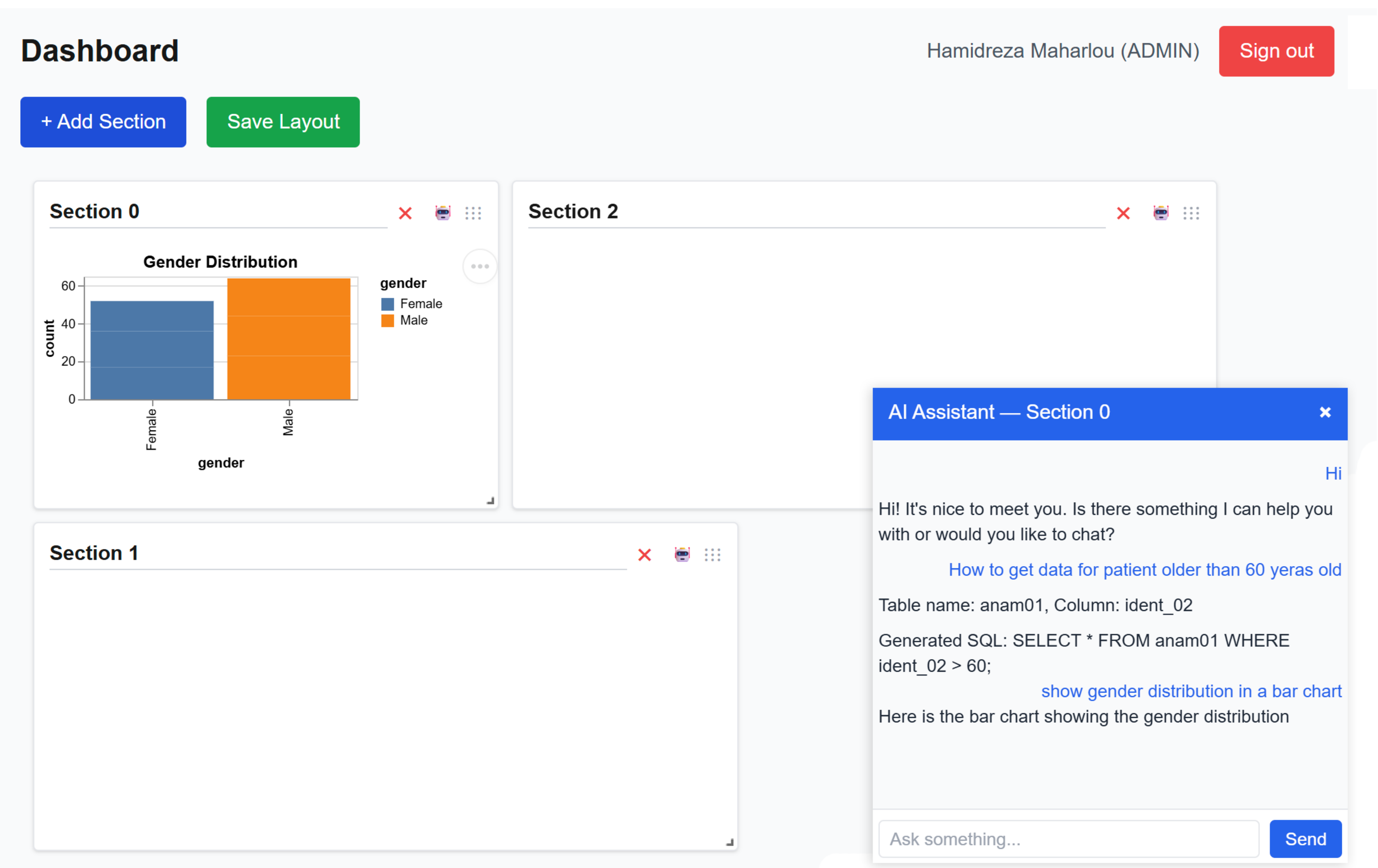


3 Features & Workflow

- **Natural-language query:** Users pose questions in plain text, e.g. *"How is participant recruitment progressing by month at each site?"*
- **AI Orchestrator (AI Router):** Interprets the request and routes it to agents, e.g. routes to **Variable Finder AI** and **SQL Generator AI**.
- **Variable Finder AI:** Identifies the dataset columns needed, e.g. retrieves **recruitment dates** and **site identifiers** for all five sites.
- **SQL Generator AI:** Creates valid SQL to query the data, e.g. a **SELECT statement** counting recruits per month per site.
- **Data Reshaper:** Adapts raw query results into a visualization-ready format, e.g. aggregates monthly recruitment counts by hospital.
- **Chart Selector & Creation:** Suggest a chart type and produces a Vega-Lite spec, e.g. builds a **line chart** of recruitment trends.
- **Guard Node:** Ensures safe execution by enforcing read-only queries, e.g. approves SELECT and blocks INSERT/UPDATE/DELETE.
- **Interactive Dashboard:** Show results in a modular, resizable canvas, e.g. displays a line chart which users can filter (single site) or link to other charts.



AI maps variables, generates SQL, and produces a chart automatically



4 Impact & Outlook

CohortCanvas introduces an AI-powered dashboard that enables natural-language interaction, secure multi-agent orchestration, and scalable deployment for cohort studies. It lowers technical barriers and supports both real-time monitoring and post-study analysis. Our approach builds on prior dashboards such as P4D [1] and relates to NL→Vis systems including NL4DV [2], Chat2Vis [3], and Lida [4]. Looking ahead, we will extend CohortCanvas with multimodal data integration, reproducible workflow trails, and advanced modules for treatment threshold detection (**CutoffFinder**), patient journey analysis (**Sequence Explorer**), and longitudinal exploration (**Time Slider**).

References: [1] P4D Dashboard (Stud Health Technol Inform, 2025); [2] NL4DV (IEEE TVCG, 2020); [3] Chat2Vis (CHI, 2023); [4] Lida (Microsoft Research, 2023).

Technische Universität Braunschweig
Hannover Medical School

Contact:

Peter L. Reichertz Institute for Medical Informatics | www.plri.de
TU Braunschweig and | Muehlenpfordtstr. 23 | 38106 Braunschweig
Hannover Medical School | Carl-Neuberg-Str. 1 | 30625 Hannover