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Research on a Low-code Data Analysis and Modeling Platform for Public Safety

Xinmeng Wang*, Shuifeng Zhang, Jingwei Wu

Nanjing Police University, Nanjing 210023, Jiangsu, China.

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***Corresponding author:** Xinmeng Wang, Nanjing Police University, Nanjing 210023, Jiangsu, China.

Abstract

With the continuous expansion of data scale in the field of public safety, how to efficiently mine and utilize massive, multi-source, and heterogeneous data to achieve intelligent analysis and decision-making is an important topic currently faced. The complex data environment and application scenarios in this field also pose numerous challenges for the practical application of algorithmic models. Therefore, this paper focused on the specific needs of the public safety field and researched and designed a low-code data analysis and modeling platform for public safety. Based on the concept of low-code, this platform significantly reduced the difficulty of use for users. It constructed a unified data integration and modeling module, enabling standardized management of multi-source heterogeneous data, and designed an intelligent graphical data comparison module that supports data comparison analysis across multiple dimensions and visualizes the results. Furthermore, the research also explored and designed aspects such as the visual expression and collaborative sharing of result analysis, as well as the low-code application of artificial intelligence algorithms. Therefore, this study effectively lowered the threshold for data analysis applications in the field of public safety and provides strong support for the digitization of public safety.

Keywords

Public Safety; Low-code; Data Analysis; Platform

1. Introduction

With the acceleration of socio-economic transformation, particularly grave situations such as counter-terrorism, maintenance of stability, large-scale crime, new types of cybercrime, regional crime, and drug-related crime, modern public safety management is facing new and greater challenges [1, 2]. The existing operations and operational mechanisms, as well as technical support capabilities, are increasingly unable to meet the demands of various aspects such as combat, prevention, control, and management [3-5]. In order to thoroughly implement the overall national security concept, construct a new pattern of grassroots social governance, and advance the important decision-making and deployment for the informatization construction of public safety management, we actively promote the transformation of public safety informatization towards a quality-oriented connotative development, paving the way for a new model featuring intelligent perception, smart applications, prediction and early warning, and precise services [6-8]. This paper intends to analyze and construct a low-code data analysis and modeling platform tailored for public safety business scenarios. This project aims to build a low-code data analysis and modeling platform for public safety business scenarios, which is a data visualization analysis platform system integrating data reorganization and management, intelligent graphical data comparison, analysis result publication and sharing, and artificial intelligence algorithm applications. Mainly driven by various practical business models and AI smart applications, it constructs practical application scenarios, continuously trains and enriches the "public safety brain," opens up the automated information pathway from data sources to application scenario data models to practical application ends, and serves

the business needs of "counter-terrorism, maintenance of stability, public security prevention and control, crime combat, emergency response, social management, and public services," forming a refined, result-oriented, cloud + end big data scenario-based empowering application for practical use by public safety management departments, creating a "brain"-"end" linkage mechanism. This provides intelligent decision-making and analysis capabilities for "high-precision" combat, prevention, control, and management, truly serving decision-making and guiding practical operations effectively.

2. Low-code Platform Management and Modern Public Safety Management

2.1 Low-code Platform: Empowering Rapid Development

Currently, the term "low-code" is no longer unfamiliar. Innovative low-code platforms have realized the abstraction of low-level coding and the automation of manual processes [9]. Through visual development tools and reusable components, low-code has shortened the delivery time of customized web and mobile applications, addressed the inefficiencies of traditional development and operations with a comprehensive set of tools, supported rapid iteration development cycles, and simplified the entire application lifecycle. In the era of low-code platform development, low-code provides a powerful enterprise-level visual development method, enabling both ordinary and professional developers to increase the speed of developing cloud-native applications on web and mobile devices by more than 10 times, simply through an intuitive graphical user interface, with the help of drag-and-drop components and model logic. Due to the global impact of the pandemic, data analysis platforms have become a new mainstay in our social life and decision-making management. However, traditional data analysis platforms take too long to develop and often fail to meet the specific needs of various business scenarios, providing users with a high-quality experience.

2.2 Modern Public Safety Management: A Low-code Approach

As modern public safety management evolves towards flattening, visualization, intelligence, and mobility, current practical work places higher demands on the timeliness of public safety big data processing and deeper practical applications [10]. This project aims to build a low-code public safety management data analysis and modeling platform, using a data visualization analysis platform technology system to achieve personalized precise analysis and services, providing intelligent decision-making and analysis capabilities for "high-precision" combat, prevention, control, and management, truly serving decision-making and guiding practical operations effectively. In order to adapt to the current social situation, it comprehensively strengthens the application of new technologies, new methods, and new skills, particularly making full use of advanced technologies such as big data and cloud computing, to promote comprehensive innovation and improvement of public safety management mechanisms, and comprehensively and effectively improve the level of information application capabilities. It innovates and optimizes mechanisms for big data-assisted scientific decision-making and social governance, promotes innovation in government management and social governance models, achieves scientific government decision-making, precise social governance, and efficient public services, and drives the in-depth implementation of the national big data strategy.

2.3 Core Research Areas: Data Handling & Low-code Applications

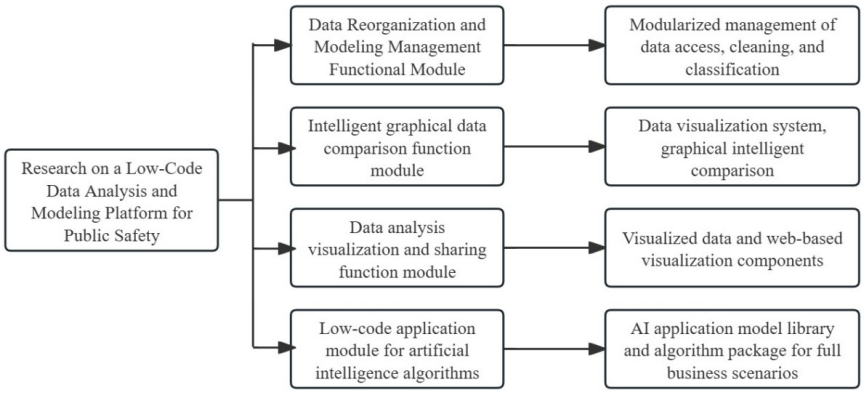

Figure 1. Research technical route.

The research in this paper mainly involves data acquisition, analysis, modeling, intelligent and graphical data comparison, as well as data analysis visualization and low-code applications. As shown in Figure 1, the main research content includes four aspects: constructing a data reorganization and modeling management functional module, constructing an intelligent graphical data comparison functional module, constructing a data analysis visualization and sharing functional module, and constructing an artificial intelligence algorithm low-code application module.

3. Building Data Reconstruction and Modeling Management Function Modules

3.1 Multi-source Data Access and Quality Enhancement

Aiming at the complex multi-source heterogeneous data in the public safety field, solutions for multi-source heterogeneous data access and management will be researched. These solutions will support flexible access to structured, semi-structured, and unstructured data, enabling automatic conversion and mapping of data formats, encodings, time zones, and other aspects to ensure the quality of data access. Secondly, data visualization cleaning techniques suitable for public safety scenarios will be studied. These techniques will assist users in identifying data quality issues and improving data quality through interactive methods. They will support operations such as missing value filling, abnormal value processing, and duplicate data deletion, bringing the original data to a state that can be used for modeling and analysis.

3.2 Dimension Management and Analysis Process Templates

A dimension management module that uniformly defines various business data dimensions according to the characteristics of the public safety field, including time, space, event types, and other dimensions, will be constructed, establishing a dimension system for subsequent multidimensional analysis. Then centralized management of dimension information will be achieved to avoid ambiguities in the definition of the same business dimension in different systems. This will be done through a template management mechanism that enables reusable analysis process design. Universal analysis process templates will be designed based on public safety business needs. These templates will include stages such as collection, preparation, modeling, and evaluation, and will feature parameterized design to enhance the reusability of process design.

3.3 Modeling Efficiency: Version Control and Data Services

A version control mechanism will be established to support version management for each component of the modeling process and to facilitate collaborative work among multiple individuals. Users can save and compare different versions of model results for evaluation and can also iteratively optimize based on existing models, comprehensively improving modeling efficiency. Lastly, considering the system's requirements for security, flexibility, and scalability, a modeling data service system will be designed that enables efficient management of massive, multi-source, heterogeneous data, providing powerful low-code data analysis and modeling capabilities for the public safety field.

4. Construction of Data Analysis Visualization and Sharing Functional Module

4.1 Graphical Data Comparison Tool Development

The primary objective of this functional module is to develop a graphical data comparison tool. With interactivity and intelligence as its core, this tool enables users to effortlessly perform data field mapping and comparative analysis through simple drag-and-drop and configuration operations. Leveraging data visualization techniques such as reports and charts, comparison results are intuitively displayed, allowing users to tackle complex data comparison tasks without the need for coding.

4.2 Multidimensional Data Analysis and Comparison

This functional module emphasizes the capability of multidimensional data comparison and analysis. Users have the freedom to select data across various dimensions such as time, space, and event categories for in-depth analysis and comparison. This multidimensional analysis approach helps users observe data variations under different combinations, enabling multi-angle comparative analysis. Users can flexibly choose analysis perspectives based on actual needs to obtain more comprehensive and in-depth analytical conclusions.

4.3 Intelligent Data Comparison and Visualization

The functional module integrates AI algorithms and visualization technologies to achieve intelligent data comparison and result display. The platform's backend is equipped with advanced algorithms such as machine learning, which can intelligently analyze and process input data, enhancing the automation level of data comparison. These algorithms can accurately analyze data characteristics and perform intelligent data mapping and matching, thereby reducing manual processing costs and improving the accuracy of comparison results. Additionally, a rich array of visualization charts, including relationship graphs, coordinate system comparison charts, and tree diagrams, are employed to vividly display complex comparison analysis results. These charts not only make the results more intuitive and easier to interpret but also support interactive operations, facilitating user diagnosis and in-depth analysis. Furthermore, the functional module includes practical judgment tools, intelligent proactive push mechanisms, and powerful functions that drive reforms and innovations in policing systems and mechanisms, contributing to the establishment of a more efficient and precise policing system.

5. Building a Low-code Application Module for AI Algorithms

5.1 Encapsulation and Low-code Invocation of AI Algorithms

The primary task of this module is to encapsulate and provide commonly used AI algorithms for low-code invocation. Tailored to the specific business needs of the public safety sector, we have encapsulated and abstracted AI algorithms such as machine learning and deep learning, developing user-friendly algorithm components. These components effectively shield the complexity of algorithm implementation, enabling users to easily apply algorithms through simple methods such as parameter configuration and component dragging. AI capabilities can be activated without the need to write code or possess data science knowledge. Furthermore, the module supports the rapid construction of algorithm applications through drag-and-drop operations on the front-end visual interface. Business users can simply drag the required algorithm models and configure corresponding parameters, and the system will automatically complete algorithm training and service deployment, achieving zero-threshold AI application.

5.2 Componentized Algorithm Library Design for Easy Expansion

This module also emphasizes componentized design for easy expansion of the algorithm library. We adopt a unified componentized design approach to build the algorithm library, where each algorithm exists as an independent component with unified input and output interfaces, enabling plug-and-play expansion. When new algorithms are needed, only new components need to be developed and integrated into the algorithm library. Additionally, the algorithm components provide simple and easy-to-use interfaces externally, completely shielding the complex processes of algorithm training, optimization, and deployment, significantly reducing the difficulty of AI application. At the same time, the module supports users in different regions to share algorithm models, enabling cross-regional collaborative application of models and improving model efficiency. Moreover, we have established a knowledge-sharing system to facilitate the exchange of algorithm application experiences. Finally, the front-end user interface seamlessly connects with the back-end cloud platform, allowing user operations to drive the execution of cloud-based algorithms and achieving efficient integration and application of front-end and back-end intelligent capabilities.

6. Summary and Prospects

This paper conducts a design study on a low-code data analysis and modeling platform tailored for public safety, addressing the complex data application challenges in this field. Firstly, a unified multi-source heterogeneous data management module is constructed to achieve centralized and standardized data management. Secondly, an intelligent graphical data comparison module is designed to enable smart and efficient data comparison. Thirdly, an open visualization and sharing module for analysis results is researched to support collaborative work. Lastly, the low-code implementation of artificial intelligence algorithms is achieved, reducing the difficulty of algorithm application. Overall, this paper fully considers the characteristics of the public safety field and adopts the low-code concept and methodology, significantly lowering the user's difficulty and simplifying complex data analysis applications. This provides effective support for the digitization of public safety.

During the research process, there are also some deficiencies. For instance, the existing algorithm library components are not yet rich enough and need continuous expansion. The sharing mechanism also requires strengthened

security controls to ensure the secure sharing of data and analysis results. Looking into the future, this research needs to focus on expanding data access channels and enriching data sources to support more comprehensive analysis and modeling. Meanwhile, the continuous development of various algorithm library components and the expansion of algorithm application scenarios are essential to meet more complex analysis needs. Additionally, exploring the use of more advanced visualization techniques to produce more expressive analysis reports is a promising direction. Finally, ensuring that the security mechanisms of the sharing platform are enhanced, effectively controlling access by different users, and guaranteeing the secure sharing and application of data and analysis results are crucial.

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