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Development of a Web-Based Traditional Market Information System Using Waterfall Model

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Abstract–The development of information technology drives digital transformation in the trade sector, including traditional markets, which serve as pillars of the people's economy. However, Pasar Anyar market in Tangerang City still faces significant challenges in the efficiency of market data management and in the delivery of commodity price information, which is currently delivered through conventional media. This research aims to design and implement a web-based information system that digitises market operations to improve public access to information. The methodology applied in this development is the Software Development Life Cycle (SDLC) with the Waterfall model, covering systematic stages from needs analysis, system design, code implementation, to testing. The system is built using modern web architecture with CodeIgniter 4 framework, Bootstrap, and MySQL database. The results show that the developed system successfully integrates all market data management, provides real-time commodity price updates, and has an effective news channel related to basic needs. Through functional testing using the Black Box Testing method, this system proved capable of running all main features with a 100% success rate and no errors in the interface logic. This implementation is expected to serve as a foundation for the digital transformation of traditional markets in Tangerang City to improve public service quality.

Keywords: Information Systems; Market Digitalization; CodeIgniter 4; Waterfall; Tangerang City; Web Service

1. INTRODUCTION

The development of information technology in the current globalisation era has had a significant impact on various sectors, including the trade sector. The utilisation of information technology, especially web-based information systems, has become an effective means to improve operational efficiency and expand a business's marketing reach (Arijanto et al., 2025). Web-based systems enable data management processes to be carried out more quickly and in a structured manner, and are easily accessible to the public without spatial or temporal limitations (Lubis & Husaini, 2025). Additionally, the use of digital technology can enhance the quality of information services and support the digital transformation process in the traditional trade sector, which has so far lagged behind the modern retail sector, which has already widely adopted advanced technology.

Traditional markets, as centres of community economic activity, play a vital role in maintaining the stability of commodity prices and meeting the daily basic needs of various social strata. However, as digital trading platforms and e-commerce rapidly develop, traditional markets are experiencing a significant decline in competitiveness in urban environments. This phenomenon is triggered by conventional marketing systems, limited data management infrastructure, and suboptimal technological literacy among market managers and traders (Arijanto et al., 2025). The lack of information about traditional markets, such as location, commodities, and facilities, becomes a barrier for the community in accessing those markets. Through this system, it is hoped that the management of market price information will become more effective, transparent, and integrated, in line with the digital transformation currently underway across various sectors of local government (Siregar et al., 2025). In addition, the manual data management process produces less effective information, takes a long time, and has the potential to lead to errors in conveying information to the public.

The issue also occurred in Pasar Anyar market, Tangerang City. As a key wholesale market and central trading hub in Tangerang, Pasar Anyar market faces significant challenges in managing thousands of market entities and a broad range of products. Currently, the mechanism for delivering market information remains not digitally integrated, leading to an information gap between management, traders, and potential buyers. This situation restricts the dissemination of promotional information about local traders' flagship products to communities outside Tangerang. Crucial information on daily commodity price fluctuations and market development news is not conveyed in real time, causing price uncertainty for end consumers. Consequently, the need for a web-based information system platform that can centralise data management has become urgent to modernise public services and bolster the local digital economy ecosystem.

Several previous studies have examined the development of web-based information systems in the trading sector. Research conducted (Siregar et al., 2025) on a web-based market price information system shows that implementing a digital system can improve data transparency, increase the efficiency of information management, and make real-time price information more accessible to traders and the public. This proves that the use of web technology in market management can support a faster and more accurate decision-making process. Additionally, the research conducted by Oktavian & Susena (2025) regarding the development of a web-based e-commerce system shows that digitalization through online platforms can expand market reach, improve operational efficiency, and make it easier for consumers to conduct digital transactions. With features such as a product catalogue, digital payment systems, and organised transaction records, business actors can enhance their competitiveness in the digital market era. Another study conducted by (Schellenberg, 2025) developed a traditional market management information system based on

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technology showing that the implementation of an integrated system can improve transparency, transaction data security, and efficiency in market administration management.

Although some previous studies have discussed web-based market information systems and the utilization of digital technology in the trade sector, these studies generally still focus on specific aspects such as transactions or market location information. Additionally, the integration of trader data, products, commodity price information, and market news into a single platform has not yet been fully developed. The implementation of a web-based market information system in traditional markets in the Tangerang City area, particularly Pasar Anyar market, has also not been extensively studied. Therefore, this research aims to develop a web-based system to support the digitalization of Pasar Anyar market in Tangerang City, thereby improving market management efficiency, expanding access to information, and increasing the competitiveness of traditional markets in the digital era.

Based on the background above, this research aims to develop a comprehensive web-based e-Market Information System for Pasar Anyar market in Tangerang City. This development uses the Software Development Life Cycle (SDLC) methodology with the Waterfall model to ensure that each design phase proceeds with a clear structure. The system is expected not only to serve as a static information medium but also to become a dynamic digitalization instrument to improve market governance efficiency, expand data accessibility for the public, and ultimately strengthen the position of traditional markets as competitive economic centres amid the global digital transformation. With this system, better data synchronisation between managers and the community is anticipated, along with the creation of a more transparent, modern, and accountable traditional trading ecosystem (Siregar et al., 2025).

2. RESEARCH METHODOLOGY

2.1 Basic Research Framework

This research is a software engineering study employing a descriptive approach aimed at analysing and developing a web-based market information system to enhance accessibility and the efficiency of information delivery to the public. The focus of the study is on the digitalization of information management at Pasar Anyar market, Tangerang City. Data were collected through observation techniques, interviews with market managers, and a review of relevant literature (Yulianti et al., 2022).

The system development in this research uses the Software Development Life Cycle (SDLC) method with the Waterfall model. The method used is the waterfall method with the stages starting with needs analysis, design, code generation, testing and support (Apriana, 2022). The Waterfall method was chosen because it has a systematic stage process and is suitable for the project's characteristics, with system requirements clearly defined from the early research stage (Kirsan et al., 2022). In addition, this model is considered effective in the process of developing a well-structured and well-documented information system.

During the system testing phase, the researcher applied the Test Driven Development (TDD) approach to ensure the quality of the code before the system was implemented. The system is built using the CodeIgniter 4 (CI4) framework as the backend, Bootstrap as the frontend framework, and MySQL managed through HeidiSQL as the database. This combination of technologies is used to support the development of a responsive, structured, and easily manageable system.

2.2 Research Stages

The research stages in the Implementation of a Web-Based Information System for Digitalizing Pasar Anyar market in Tangerang City consist of several stages as follows:

a. Needs Analysis
   At this stage, data collection is carried out through observation, interviews, and literature review. The combination of qualitative field methods and literature studies is highly effective in data-driven requirements analysis, allowing developers to extract both explicit and latent operational challenges within the research object (Maulana & Rachmatika, 2026). Observation is conducted directly at the research site, while interviews are conducted with managers and traders at the market. A literature review is performed to obtain references from relevant journals and literature. The results of this stage include identifying system needs and existing problems.
b. System Design
   The system development model used is the waterfall model with fives tages, namely system requirements analysis, system design as a web-based system blueprint, coding, black boxtesting and system maintenance (Siahaan et al., 2022). The design includes creating flowcharts, use case diagrams, and database designs using Entity Relationship Diagrams (ERD). Additionally, interface (UI) design is also carried out to facilitate users in operating the system.
c. System Implementation
   The implementation phase is the process of building the system based on the design that has been created. The system is developed using the PHP programming language with the CodeIgniter4 framework and MySQL databaseAt this stage, the main features such as trader data management, product data, market information, and transactions are integrated.

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d. System Testing
System testing was conducted using the Black Box Testing method. This testing aims to ensure that all system functions operate according to the specified requirements without examining the program code.

e. System Maintenance
The maintenance phase is carried out after the system is implemented. During this stage, corrections are made to any errors found, and additional features are developed according to user needs.

Linear sequential proposes an approach to systematic and sequential software development that starts at the system level and progresses throughout analysis, design, code, testing and maintenance (Sumarno, 2021). The Waterfall Model was chosen because it provides a clear, systematic workflow, making the development and documentation processes easier (Rahmi et al., 2023).

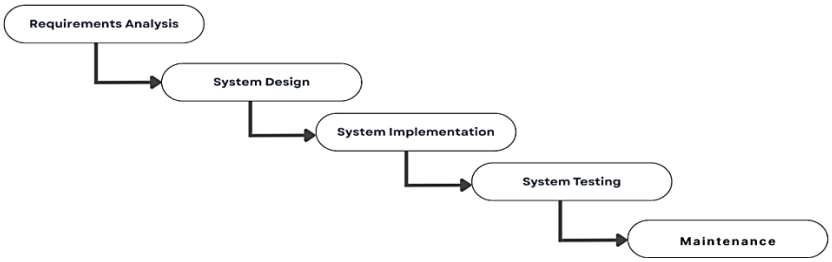

Figure 1. Waterfall Model

2.3 System Design

This design aims to identify functional requirements so that the system can address the issues of miscommunication and data inconsistency that have long plagued the manual system (Sutrisno et al., 2026). This phase aims to design the system architecture, data flow, and user interface. The design is carried out using use case diagrams, flowcharts, and Entity-Relationship Diagrams (ERD) (Sinta et al., 2026).

2.3.1 Entity Relationship Diagram (ERD)

The Entity Relationship Diagram (ERD) is used to model the logical relationships among entities in the database for the developed market information system. This tool can show the main entities involved, the important attributes they have, and the relationships between entities, and it also enables the definition of cardinality relationships between those entities (Pulungan et al., 2022).

Some of the main entities identified in the system architecture include Admin, News, Gallery, Video, Feedback, Market, and Commodities. In addition to these entities, there are several specific relationship tables, such as Market_Commodities and Commodity_Prices, that dynamically manage data. Implementing an ERD ensures the integrity and consistency of data relationships within the system. As an illustration of features, the admin entity can add news, galleries, or videos, which can then receive feedback from users. On the other hand, market data is connected to various available commodities to provide comprehensive information, including real-time fluctuating commodity prices.

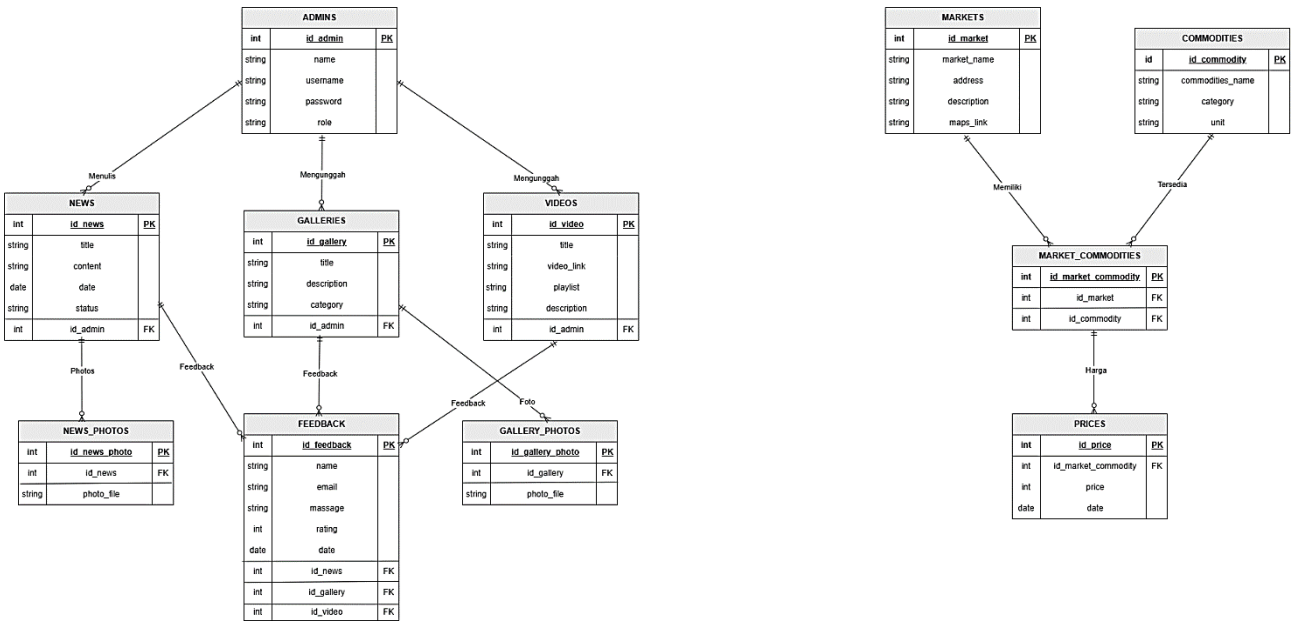

Figure 2. Entity Relationship Diagram

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The system design, which has been modeled with an Entity Relationship Diagram (ERD), is divided into two main functional domains to ensure data integrity and efficiency. First, in the content management domain, the ADMIN entity has a one-to-many (1:N) relationship with the NEWS, GALLERY, and VIDEO entities. Each of these contents is connected to the FEEDBACK entity to accommodate user interactions. To support visual representation without data redundancy, multi-image storage is accommodated through the entities NEWS_PHOTO and GALLERY_PHOTO.

Secondly, in the microeconomic domain, the system models a many-to-many relationship between the Market and Commodity entities, which is resolved through the Market Commodity associative entity. To accommodate historical data fluctuations, the Price_Commodity entity must be linked to this associative table to record changes in commodity prices over time. Overall, the Entity Relationship Diagram (ERD) model is implemented in a relational database (MySQL) with structured Primary Key (PK) and Foreign Key (FK) identifications to maintain system consistency and referential integrity.

3. RESULTS AND DISCUSSION

3.1 System Development

The stage is the realization of the system design into functional program code. In this e-Market information system, the implementation includes various main modules such as Home, News Page, Multimedia Gallery, Video Playlist, and Market Price Information, with data based on a case study at Pasar Anyar market in Tangerang City. This digital transformation directly replaces the traditional management system into a centralized web platform, addressing previous challenges such as physical accessibility constraints and information asymmetry for the public.

3.1.1 Development of Public Pages

The development of the public interface or frontend was carried out using the CodeIgniter 4 (CI4) framework by applying the MVC (Model-View-Controller) architectural pattern. The pages available to general users include Home, About Us, Information, Gallery, FAQ, Feedback, and Contact. All of these interfaces are designed based on high-fidelity mockups that were previously prepared to ensure the quality of the User Interface (UI).

In terms of visual technical aspects, the system uses the Bootstrap framework that has been customized through Cascading Style Sheets (CSS). This aims to produce a display that is not only professional and consistent but also highly responsive (fully responsive). As a result, this information system can be accessed optimally across various devices with different screen sizes, ranging from desktop computers to mobile devices. As a result, this information system can be accessed optimally across various devices, ranging from desktop computers to mobile devices, as shown in Figure 4.

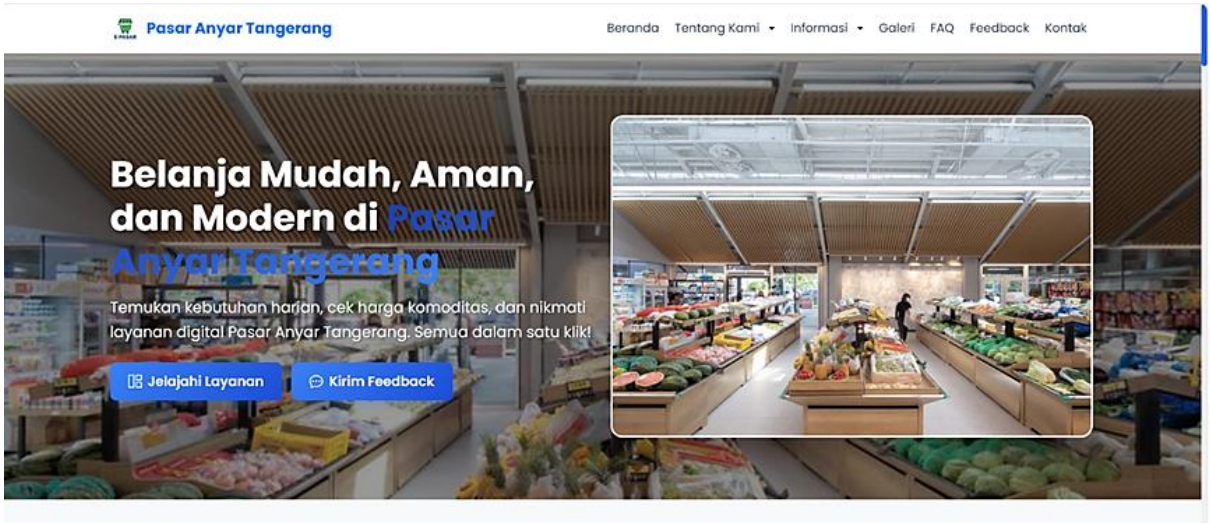

Figure 3. Homepage Display

The news page uses a card-based layout to display the latest articles systematically. This setup aims to enhance user experience by making reading and browsing easier. Each card contains a dynamic link that takes users to a detailed news page for more in-depth information. On the detail page, users find a comprehensive overview of market dynamics, with social media sharing features to help spread the news widely across platforms. This functionality is expected to boost the reach and engagement of the Tangerang City New Market Information System, providing the public with a timely and trustworthy source for price trends and market activities.

The Commodity Price Page serves as a transparent tool for food price information in Pasar Anyar market. Previously, price updates were communicated manually through physical boards or ledgers, often leading to delays. The page includes a dropdown menu for selecting commodity categories to organize data, and a datepicker that enables

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users to filter information by specific periods. Real-time data display is its key advantage, ensuring accuracy and helping to prevent price manipulation by middlemen. The commodity price detail module incorporates data visualization components that show graphical summaries of price changes over time. This technical approach allows users to analyze trends in periodic price fluctuations. With these visual tools, the public and market managers can make more effective economic decisions based on current daily data.

The Anyar Market Profile Page in Tangerang City contains several pieces of information, such as the market's history, vision and mission, operating hours, contact details, social media, and geographic location. The Anyar Market in Tangerang City is located on Jl. Jend. Ahmad Yani, Sukasari, Tangerang City, via an interactive Google Maps API, as illustrated in Figure 5. This digital transformation can improve physical accessibility and provide convenience for the community through flagship services that include informative and educational aspects.

In terms of architectural implementation, the seamless presentation of these public pages is achieved by leveraging CodeIgniter 4's Model-View-Controller (MVC) pattern combined with a responsive Bootstrap framework. By decoupling the database access logic from the user interface, the system ensures that user-driven requests—such as filtering price logs via the datepicker or loading the interactive Google Maps API—are executed efficiently with minimal server overhead. Furthermore, the integration of customized CSS guarantees that the layouts dynamically scale across a wide range of devices, from desktop monitors to smartphones, without breaking the visual interface. To optimize performance further, the system employs efficient data-fetching techniques on the backend, preventing page latency even as the commodity historical data grows over time. Security measures, including asynchronous data sanitization and request filtering, are also applied to these public modules to prevent unauthorized manipulation of information. This comprehensive frontend and backend optimization effectively transforms the public portal into a secure, low-latency, and user-centric digital environment that fosters long-term market transparency for Pasar Anyar market.

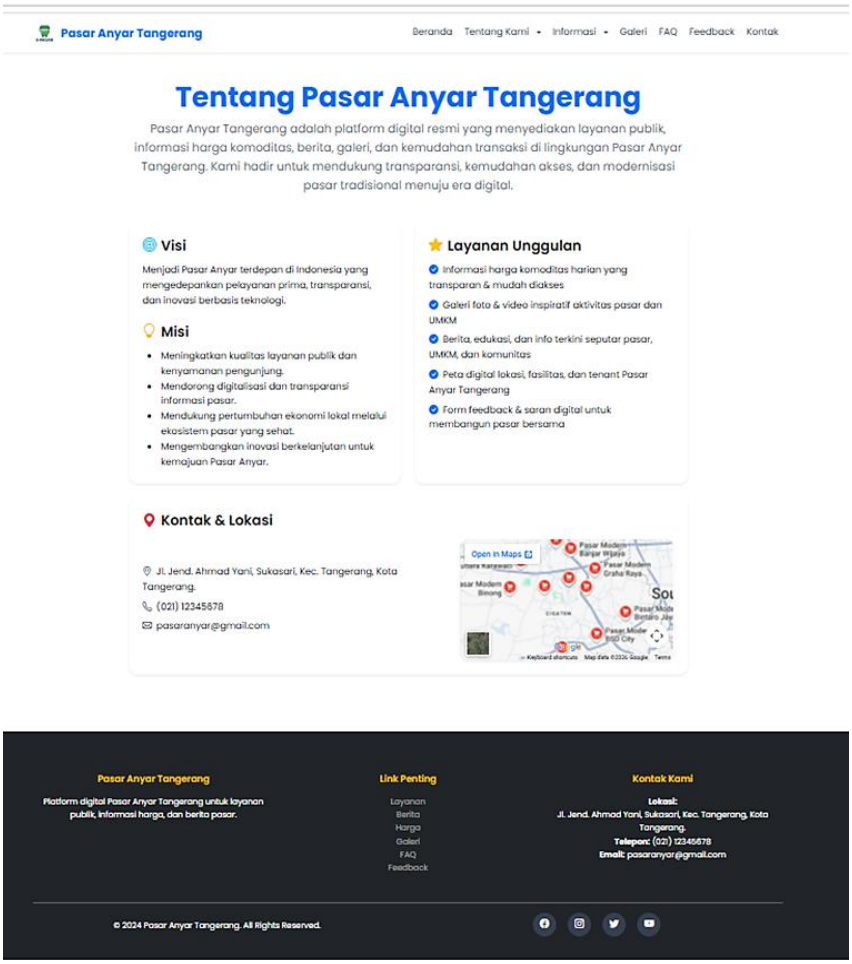

Figure 4. About Page Display

The Gallery page is developed as a multimedia-based information presentation center that integrates visual elements such as photos and videos. This interface is equipped with two main navigation components to separate image content from audiovisual content. In the photo module, the system displays various documentation of products and activities at Pasar Anyar market to provide an accurate visual representation for prospective visitors.

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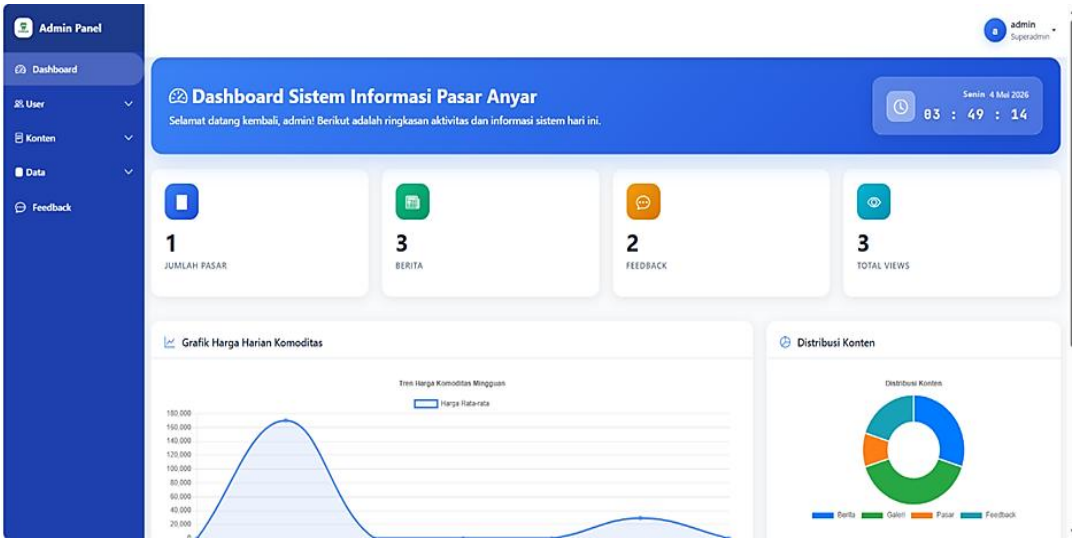
Meanwhile, in the video module, the system implements a video player with embedded YouTube API support to ensure server bandwidth efficiency. This feature is equipped with a playlist and intuitive playback controls to make navigation easier for users. When a user selects a specific video title, the system directs them to a video player page that provides an in-depth description, video metadata, and related content recommendations. This multimedia integration aims to enhance the system's interactivity and deliver market information in a more engaging way. The FAQ page on the Pasar Anyar market information system uses an ergonomic structural approach. On that page, a list of common questions along with their answers is displayed in an accordion format to facilitate navigation with an organized structure. The system allows for on-demand interaction.

3.2 Development of the Admin Page

The Admin Login page is designed as the central content management and data hub within the market information system. Its main foundation lies in authentication, including login and logout processes supported by session management and CSRF protection to ensure secure access to the system.
The Admin Dashboard page is designed as the main hub for controlling the data abstraction system and activities comprehensively. This implementation aims to provide an efficient overview so that administrators can monitor and control the system easily without having to explore it in depth. Functionally, the presented identity includes real-time features that display crucial metrics such as the number of markets, news accumulation, and total visits, which can be seen in Figure 6.



The Admin User page is developed as a strategic management tool to centrally govern users. The main focus of this module is to provide full control to administrators to manage access rights, monitor user activities, and mitigate system security risks through strict authentication mechanisms. This page is equipped with an integrated user registration feature to ensure the validity of new user data. The system presents a user list table containing identity details and authorization levels divided into three tiers: Superadmin, Admin, and Content. Each level has different access rights according to its functional role within the system. Additionally, there is a feature for the last activity log that allows accurate monitoring of each account's activity for security audit purposes. To keep the data up-to-date, administrators are granted the authority to update (edit) or delete user data in accordance with the applicable identity management procedures. The Role Management Admin Page serves as a tool to systematically organize user access levels. Its purpose is to implement access rights based on each role's specific responsibilities, enhancing security and data integrity within the system. The page features an intuitive interface for easily adding new roles, allowing the system to grow alongside the organization. Additionally, it includes a responsive search function that helps administrators quickly locate role data, ensuring that authorization updates are managed efficiently and documented properly. The Content Admin Page is developed as an integrated digital ecosystem that facilitates comprehensive management of news entities, photo galleries, and videos. This module is designed to support information dissemination within the Tangerang City New Market Information System through systematic content governance. In this module, administrators have full authorisation over the entire content publication cycle to ensure professionalism and the validity of the information presented to the public.

The control mechanism on this page includes primary data manipulation functions consisting of adding (create), modifying (update), and deleting (delete), as well as managing the publication status of content. Data and information organisation is carried out in a structured manner through an interface that allows administrators to monitor all multimedia assets in a centralised dashboard. With this content management integration, market dynamics updates can be performed quickly and accurately, ensuring the information remains current for the public.

To support comprehensive transparency in market information, the system implements an Admin Data module that includes the Market Data Page and Price Data Page, serving as the central control for economic information. The

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Admin Data Market Page is designed to facilitate administrators in managing macro-market parameters, including market profiles, the classification of active traders, and the monitoring of inactive traders to maintain the accuracy of the tenant database.

Meanwhile, the Admin Price Data Page module is developed to ensure the accuracy of daily price information through an input data mechanism equipped with strict numerical validation. The system automatically records a timestamp on each data entry to ensure information accountability. Additionally, a price history update (log update) function is available, allowing administrators to correct historical data when commodity values change. The integration of this feature ensures that the price fluctuations presented to the public have high referential integrity and are accountable.

The Admin Feedback page is designed as a centre of inspiration and a user response to support transparent decision-making. Efficiency on this page is achieved through features such as data export to external formats for in-depth data analysis, mechanisms that are prioritised for handling, and synchronisation to ensure information validity without disrupting interactions on the system page.

3.3 System Testing.

System testing was conducted using the Test Driven Development (TDD) method. The implementation of Test Driven Development (TDD) in software development provides a more systematic approach by prioritising the creation of test scenarios before the program code is implemented (Elzatar et al., 2022). This method allows developers to understand functional requirements more deeply through an iterative cycle known as Red-Green-Refactor. In the context of inventory or market data management systems, TDD plays an important role in maintaining design flexibility when system requirements change in the future (Elzatar et al., 2022).

In addition to unit testing, integration with Continuous Integration (CI) systems is a key factor in maintaining product quality continuously. Implementing CI ensures that every code change is automatically tested through a series of tests, minimising failures when the application is released (Jaeni et al., 2022). By combining TDD and CI, the quality and reliability of the system can be ensured through comprehensive testing stages, from unit testing to system testing(Hidayat et al., 2025).

Testing was conducted using the PHPUnit framework on CodeIgniter 4. Based on the TDD that has been implemented in the Tangerang City New Market Information System, here are the results of the testing phase:

Table 1. PHPUnit Framework Testing Stage

No	Module	Test Scenario (Unit Test)	Red Stage (Initial Status)	Green Stage (Code Implementation)	Refactor Stage (Optimization)	Final Status
1	Authentication	Admin login validation and dashboard session protection.	Fail: Route has not been defined.	Pass: Addition of auth() logic in the Controller.	Separating filter/middleware logic for a cleaner structure.	Verified
2	News	Adding news data through the create() method on NewsModel.	Fail: The create() method does not exist in the Model.	Pass: Addition of the insert() function for news data.	Query optimization to speed up image loading.	Verified
3	Photo Gallery	Upload an image file in a valid format (.jpg, .png).	Fail: File validation function has not been created.	Pass: Implementation of request->getFile() and validation.	Standardization of variable file naming in the database.	Verified
4	Video	Integration of video links and content playback on the public page.	Fail: Video embed scenario failed to run.	Pass: Addition of URL video parsing function.	HTML structure improvements to make it responsive on mobile.	Verified
5	Market Price	Input daily price with numeric data type validation.	Fail: The system received text input (database error).	Pass: Addition of is_numeric validation on the form.	Automatic timestamp synchronization when entering data.	Verified

Through the TDD method, testing not only identifies bugs but also serves as technical documentation, ensuring that each feature in the module meets the acceptance criteria established from the beginning of development.

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3.4 System Maintenance

The Pasar Anyar market Information System implements an error-handling feature with an integrated logging mechanism using the CodeIgniter 4 framework. Based on the strategies already applied through two approaches: the development stage for detailed error information during debugging, and the production stage, which hides technical interface details (such as 404 Not Found pages) to protect information security from potential system exploitation (Fahmi Al Azhar & Harwahyu, 2023). Additionally, to ensure operational stability, critical processes such as data upload and storage are encapsulated in try-catch blocks to prevent the application from crashing unexpectedly in the event of infrastructure or server failures (Ali et al., 2022). This security structure guarantees that the trade information system remains highly accessible with minimal downtime.

3.5 Discussion

The results of this study are aligned with the findings of Siregar et al. (2025), which demonstrated that digital market information systems can significantly enhance the clarity and availability of commodity price data. Through a similar approach, the information system developed for Pasar Anyar Market is proven to facilitate the public in accessing market information in real-time via a web platform. The current study expands upon previous research by integrating various information services into a single, comprehensive platform, which encompasses market profiles, commodity price search, news management, multimedia galleries, and public feedback channels. While Siregar et al. (2025), primarily focused on the visualization of market price data, the system proposed in this study offers a broader strategic scope for the comprehensive digitalization of traditional markets.

From a practical perspective, the deployment of this web-based system carries significant managerial implications for the local government and market authorities. By consolidating trade data into a single, accessible platform, municipal administrators can closely monitor daily price dynamics, allowing for faster policy intervention during sudden inflation or supply shortages of staple goods in Tangerang City. For the merchants of Pasar Anyar, the integrated multimedia and news infrastructure serves as a free digital marketing engine, amplifying their visibility to a broader urban consumer base that is increasingly reliant on digital media.

4. CONCLUSION

This research successfully develops a web-based information system as an effective instrument for digitalizing trade information at Pasar Anyar market, Tangerang City. Built using the CodeIgniter 4 framework, Bootstrap, and a MySQL database under the Waterfall SDLC model, the platform seamlessly integrates market data management, dynamic commodity price updates, and public news into a single portal. The implementation results demonstrate a significant improvement in the operational efficiency of market managers and provide the general public with real-time, transparent access to staple food prices, effectively mitigating previous delays inherent in conventional systems. Despite these achievements, this study is limited by its primary focus on one-way information dissemination, the absence of direct e-commerce transactional features between traders and buyers, and a heavy reliance on manual data updates by administrators. Therefore, future research should focus on implementing digital payment pathways (e-payment) and automating price data collection through Internet of Things (IoT) sensors to minimize human error. Overall, this system establishes a reliable model for traditional market digital transformation, enhancing public service quality and local economic competitiveness in the digital era.

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