

The Design of a Good Data Processing App Applying QR Code

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Abstract: Designing a good data processing application using QR Codes aims to increase efficiency and accuracy in data management. QR codes are a fast and easy technology for storing and scanning data, allowing users to quickly access information without entering data manually. This application is designed for various purposes, such as inventory, time and attendance management, and document tracking. The application design process includes user needs analysis, interface design, back-end development, and integration with QR code technology. The prototype method is used during the system development stage. The programming language used is a hypertext preprocessor with a MySQL database, and a framework is used to ensure that the application behaves as expected and can provide effective solutions in data processing. The results of this design are expected to significantly contribute to operational efficiency, reduce human error in data entry, and increase the speed of accessing and managing information. Apart from that, implementing QR codes in data processing applications is hoped to be widely used in various industries and business fields.

Keywords: Design; MySQL; Prototype Model; QR Code

INTRODUCTION

The need for fast, efficient, and accurate data processing is increasing in today's digital era. Data is an important asset in any organization or business, so its management is very important (Hilabi et al., 2019). QR Code is a technology that increases the efficiency of data processing (Rosella et al., 2024). QR Code (Quick Response Code) is a two-dimensional matrix code that can store information efficiently, be used on devices with compatible capabilities, have adequate features, and be easily accessible via smartphone (Lubis et al., 2018).

The use of QR Codes in data processing is a testament to efficiency, offering numerous benefits such as reducing human error in data entry, speeding up the data retrieval process, and facilitating the exchange of information (Adhiwibowo & Mahmud, 2021). QR Codes can be used in various contexts, such as inventory, time and attendance management, document tracking, etc (Sitorus et al., 2023).

Computing applications that use QR Codes are designed to meet this need by providing an integrated and user-friendly solution (Mulyadi et al., 2023). This application will help organizations and businesses manage their data more efficiently and effectively (Mohamad Ali Murtadho, 2016). In developing this application, it is necessary to consider various aspects such as analyzing user needs, designing an intuitive interface, creating a reliable backend system, and conducting testing to ensure the application functions properly.

This implementation uses website media and QR Code technology to display product information data quickly. By combining a website with product information data and a QR Code that displays product information data when scanned, the goal is to provide convenience for those responsible for managing and monitoring their products.

Ensuring data accuracy is a cornerstone of any successful company (Octavia & Dafid, 2022). To obtain accurate data, companies need data processing activities. The company's product data processing activities are carried out continuously every year. For product data processing in a company to run well and correctly, it is necessary to develop an application in the form of a goods data processing management information system (Nuraeni et al., 2022). Companies have more data every year, and data management becomes more difficult if using traditional or non-computerized methods. To support data management in companies, it is necessary to develop an information system in the form of a computer-based information system for processing goods data (Muhammad Afif Dzaky Khairullah et al., 2023).

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PT. Pelabuhan Cilegon Mandiri is a regional company engaged in the management and service of the port sector. The problems that arise when recording product inventory and demand are still handled manually. This makes processing and reporting item data very difficult. This means frequent errors, relatively slow calculation of receipts and shipments, and delayed reporting. The company needs a program to help record, audit, calculate, and produce accurate reports of receipts and expenditures of inventory to avoid data errors with the potential of more than 30 industrial ports located in Cilegon City, PT. Pelabuhan Cilegon Mandiri always strives to provide fast, reliable, and safe services that meet national and international standards.

Several studies have been conducted in recent years related to the design of goods data processing applications. The 2021 study conducted by (Pranajaya & Suwanda, 2021) found that a website-based information system using QR Code technology has created an IT equipment inventory information system that can facilitate data processing to make the right decisions. Designed to support the optimal implementation of IT department activities. While the research conducted by (Aldo et al., 2022) with the presence of the inventory data processing information system website, it is hoped that it will provide more effective and efficient delivery of goods data reports.

The purpose of this study is to describe the design and development process of a QR Code-based data processing application and the benefits that can be obtained from implementing this technology. Thus, it is hoped that it can provide a comprehensive understanding of the importance of using QR Codes in data processing and how this technology can improve operational efficiency.

LITERATURE REVIEW

QR Code Technology

QR codes are two-dimensional barcodes that can encode various types of data, including URLs, text, and contact information. According to (Chen et al., 2023), QR codes have advantages over traditional barcodes, such as higher data capacity and the ability to be scanned from different angles. This versatility makes them suitable for applications requiring quick data retrieval and processing.

QR Code is a technique that converts written data into 2-dimensional codes printed into a more compact media. Barcodes were first used for vehicle spare parts production inventory data and are now used in various fields. QR stands for Quick Response because it is intended to translate its contents accurately. QR Code is a development of a one-dimensional barcode. QR Code is one type of barcode that can be read using a cellphone camera.

QR Code can store all data types, including Numeric, Alphanumeric, Binary, and Kanji/kana. In addition, QR codes have a smaller display than barcodes. This is because the QR Code can accommodate data horizontally and vertically, so the image display size is automatically reduced to one-tenth of the barcode size. In addition, the QR Code is resistant to damage because it can correct up to 30% of errors depending on its size and version. Therefore, the data can still be stored and read even if some QR Code symbols become dirty or damaged. The three square marks in the three corners ensure that the symbols can be read from any angle with the same results (Obeng et al., 2024).

Each version of the QR Code symbol has a data capacity depending on the amount of data, character type, and error correction level. Maximizing the version and data capacity will increase the amount of data and modules, so that the QR Code symbol becomes larger Figure 1.



Fig 1. Versi simbol QR Code

QR Code has an error correction capability to restore data if the code is dirty or damaged. Four error correction levels are available to users; these levels can correct errors in the QR Code. Environmental factors and QR Code size must be considered to determine the error level. Level Q or H can be selected if the ecological conditions are dirty, which will cause the QR Code to be damaged, while level L can be chosen if the environmental conditions are clean with a large amount of data. Level M is the most frequently used level. The following is a table of QR Code error correction (Dey et al., 2021).

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Table 1. QR Code Error Correction

QR Code Error Correction Capacity	
Level L	Can correct errors up to 7%
Level M	Can correct errors up to 15%
Level Q	Can correct errors up to 25%
Level H	Can correct errors up to 30%

Application Design Principles

The design of a data processing app that employs QR Codes should adhere to several key principles:

- User-Centered Design:** The application should prioritize user experience (UX) by conducting user research to understand the needs and preferences of target users (Familoni & Odetunde Babatunde, 2024). This involves iterative design processes that include prototyping, testing, and feedback.
- Simplicity and Clarity:** The app's interface should be intuitive, minimizing the learning curve for users. Research by (Durgekar et al., 2024) emphasizes the importance of clear navigation and minimalistic design elements to enhance usability.
- Responsiveness:** The app should function effectively across various devices and screen sizes, as users may access it on smartphones, tablets, or desktop computers. Responsive design techniques help ensure a seamless experience (Abbas et al., 2024).
- Security and Privacy:** Given the sensitive nature of data often processed through QR codes, applications must implement robust security measures. This includes data encryption and secure access protocols to protect user information (Ferrag et al., 2022).

User Experience and Interaction

The interaction between users and the QR code scanning feature is crucial for the app's success. A study by (Liu et al., 2021) found that providing instant feedback upon scanning a QR code significantly enhances user satisfaction. Furthermore, integrating visual cues, such as animations or confirmations, can help guide users through the scanning process.

Applications in Various Domains

QR codes can be integrated into data processing apps across various sectors:

- Healthcare:** QR codes can facilitate patient data management, appointment scheduling, and medication tracking (Badiola-Zabala et al., 2024). An app designed for healthcare professionals could streamline these processes by allowing quick access to patient records via QR code scanning.
- Retail and Inventory Management:** Applications that utilize QR codes for inventory tracking can improve efficiency and accuracy. By scanning codes, employees can quickly update stock levels and manage product information (Elaskari et al., 2021).
- Event Management:** QR codes can simplify ticketing processes by allowing attendees to gain entry through scanned codes, thereby reducing waiting times and enhancing the overall event experience (Al Amin et al., 2024).

The design of a good data processing app that leverages QR code technology involves a multifaceted approach that prioritizes user experience, security, and domain-specific functionality. As QR codes continue to evolve, further research is needed to explore innovative applications and improve the usability of these systems.

METHOD

This study adopts a system development method using a prototype model. This method is a software development model commonly used by developers to interact with users during the system development process. The prototype model image is displayed with the following stages:

- Communication**
Gathering information on system requirements and an overview of the software to be created.
- Quick Plan**
This is done to determine the prototype production plan. This phase is executed quickly to determine the overall software development plan.
- Modelling Quick Design**
This is done by creating a design that represents every aspect of the software that will be used, and this design becomes the basis for developing a prototype.
- Construction of Prototype**
It was done in a programming language that the computer can understand. The result of this stage is a software

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prototype ready to be evaluated.

5. Deployment Delivery & Feedback That is, evaluating the prototype created and used to clarify software requirements and evaluate the success of software development.

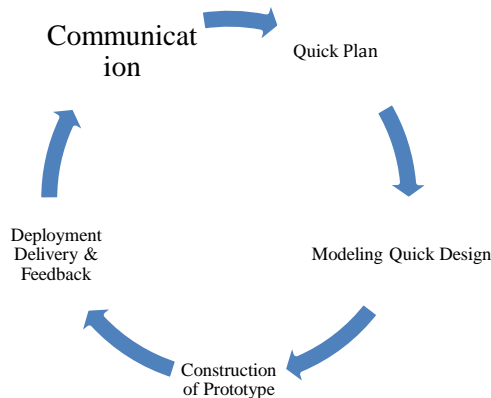


Fig. 2 Prototype Model

[pp. 69–79 A. Buku et al., “Jurnal ilmu komputer,” vol. 11, no. 2, 18 @ *jik.htp.ac.id*. 2022.

RESULT

System implementation converts a plan or concept into a tangible, operational form. It involves designing, developing, testing, and launching a system that meets the stated goals and needs. System implementation can occur in various contexts, including information technology, manufacturing, healthcare, and other sectors. It is important to understand that system implementation is not just about installing hardware or software but also involves changes in business processes, employee training, and effective change management. In addition, the success of a system implementation often depends on a deep understanding of business objectives and user needs. A strong sense of the system's role in achieving organizational goals is essential. Continuous monitoring and evaluation are required throughout the implementation process to ensure the system performs well and to its original purpose. By carefully managing system implementation, organizations can maximize its benefits, improve efficiency, and maintain user satisfaction.

The next step is the implementation stage, after the system is analyzed and designed thoroughly. Implementation is the stage where the design based on the analysis results is translated into a specific programming language, and the software created is implemented and operated in a real environment. This implementation is intended to validate the design module for user input to the system developer.

A. Communication

Communication is an important stage that continuously occurs between developers and users during development. This process aims to ensure that the prototype created is by user needs and expectations and allows direct feedback for further refinement. Here are some important aspects of the Communication stage in the prototype model:

1. Initial Consultation with Users

In the early stages, developers communicate with users to identify their needs, expectations, and basic specifications desired in the final product. This consultation helps avoid misunderstandings and becomes the basis for creating an initial prototype.

2. Collecting User Feedback

After users try or observe the prototype, they provide feedback on features, functionality, and design elements. The developer then records user suggestions, criticisms, or requests, which will be used to refine and improve the prototype.

3. Iteration and Revision Based on Communication

Based on feedback, developers revise or iterate on the prototype. This process can occur many times in the prototype cycle, so ongoing communication between developers and users is essential so that the final result is close to user needs.

3. Discussion of Constraints and Additional Needs

During iterations, developers and users may discuss technical or budget constraints or the addition of features not previously considered. This communication helps users understand limitations and allows developers to adjust functionality based on priorities.

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4. Final Product Presentation or Final Prototype

After several iterations and refinements, the prototype reaches the final stage, close to the final product. The developer resubmits the product to the users for approval before the final implementation or product launch.

With ongoing communication at every stage, the prototype model allows for development more responsive to user needs and expectations, minimizing the risk of misalignment between the product and user needs late in the development process.

B. Quick Plan

In prototyping, a "Quick Plan" typically refers to a quick, accurate, and simple work plan created in the early stages of development or prototyping. A Quick Plan identifies basic needs, goals, and key steps to be taken without going into too much detail. This allows the team to quickly begin the prototyping process and clearly understand what needs to be done without creating an overly complex or detailed plan. With ongoing communication at every stage, the prototype model allows for development more responsive to user needs and expectations, minimizing the risk of misalignment between the product and user needs late in the development process.

Key elements often included in a Quick Plan include the key features and functionality to be tested or visualized, the target users or stakeholders who will use or evaluate the prototype, and key information needed to create the prototype, such as Scoping activities, identifying functionality, initial design, component manufacturing and testing, estimated time required, and allocation of available resources to complete the prototype. The Quick Plan is typically created to help the team move quickly through developing and evaluating the prototype without getting too bogged down in details that may change as the project progresses.

C. Modeling Quick Design

In prototyping, "quick design" or "rapid design" refers to a rapid design phase that aims to create a first draft of a prototype. This Quick Design is a simple initial step, but it is enough to provide a visual explanation and basic concepts of how the system or product works and looks. This allows the team and stakeholders to understand the prototype's key elements and important features without making the Design too detailed or formal. Quick Design is essential in prototyping because it allows the team to get feedback from users and stakeholders, allowing for improvements or adjustments before moving on to more detailed development phases.

D. Construction of Prototype

"Building a prototype" or prototype development in the prototype model is the stage where the initial design (Quick Design) is developed into a more concrete and interactive prototype form. This phase transforms the ideas and concepts designed in Quick Design into a format that can be tested and evaluated. The main goal of this phase is to create an early version of the product or system that allows users and stakeholders to see, interact, and provide feedback. The prototyping phase is the core of the prototyping process because this is where ideas become reality. Once the prototype is created, the team can conduct further testing and gather feedback to improve or modify certain aspects.

1. Register Page

The registration page is used to register new users. Users who do not have an account must register first. The registration page is shown in Figure 2.

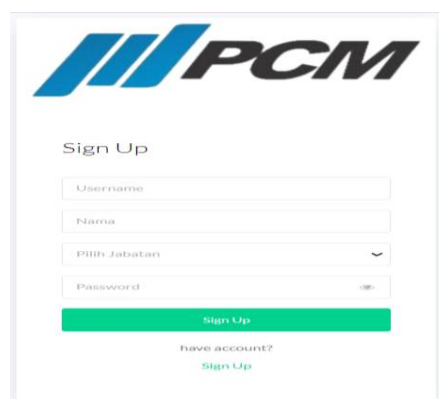


Fig. 3 Staff Register Page

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When the user registers, the system will check the registration input form. If the data is collected by request, the system continues the registration process. The system sends an account activation link via the email entered during registration to verify the registration.

2. Login Page

Implementing a login system is a key part of many applications and platforms that require restricted and managed access. The login system is the first step to identify users, grant appropriate access permissions, and protect sensitive data. Login implementations involve several elements, including login forms, user databases, data encryption, and verification steps, such as two-factor authentication. In the context of increasingly important information security, developers must ensure that the implemented login system is secure and resistant to attacks, such as credential theft. The login page is used to start using the application. If the user already has an account, they can log in using the account registered in the system. The login page is shown in Figure 4.

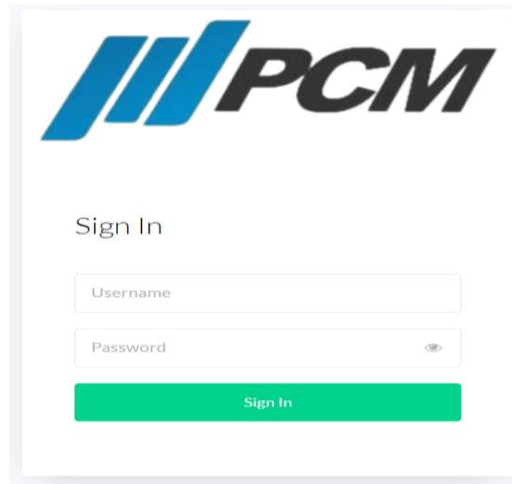


Fig. 4 Admin and Manager Login Page

When logging in, users are asked to enter a username and password that matches the username and password used when registering.

3. Dashboard Page

Implementing a dashboard is important in developing applications and systems that store, manage, and analyze data in a structured format. Proper management of dashboard pages allows applications and systems to store, access, and analyze information with high efficiency. This page includes the menu of goods data, incoming goods, outgoing goods and reports. The dashboard page is shown in Figure 5.

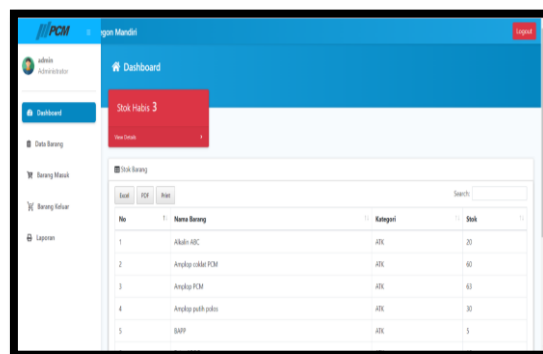


Fig. 5 Admin Dashboard Menu

4. Item Data Menu Page

The admission screen page displays the item name, category and inventory. It has buttons that can be used to manage document data. The admin item data menu is shown in Figure 6.

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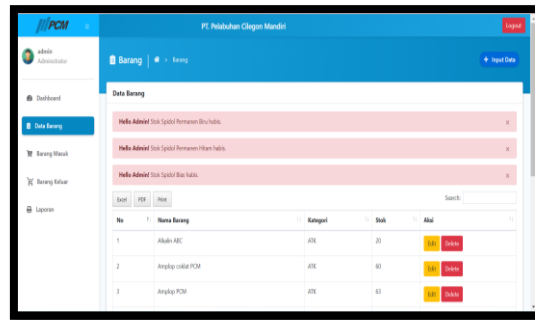


Fig. 6 Item Data Menu

5. Report Menu Page

The goods report page used by the administrator consists of the name of the goods, category, incoming goods, outgoing goods, and stock. The appearance of the report menu page is shown in Figure 7.

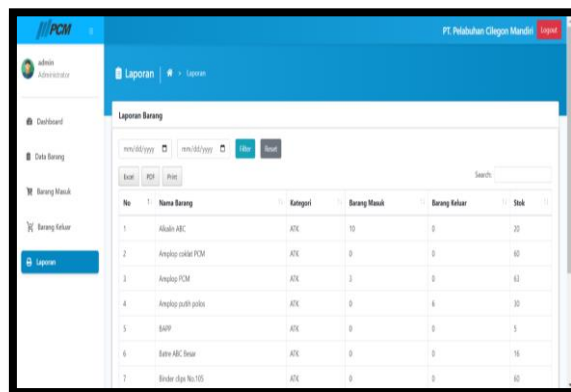


Fig. 7 Admin Report Menu

6. QR Code Page

The administrator uses the QR Code page to collect data and minimize errors. The display looks like Figure 8 below:



Fig. 8 QR Code Sistem

E. Deployment Delivery & Feedback

"Deployment, delivery, and feedback" in the prototype model is the phase where the prototype created is handed over to users and stakeholders for testing and evaluation. The main purpose of this phase is to identify deficiencies, receive direct feedback, and understand whether the prototype meets the needs and expectations of users.

Here are the details of the implementation process and feedback on the prototype model:

1. **Deployment:** The prototype is created and implemented in a user or test environment. This process may include installing software, integrating with other systems, or creating instructions for using the prototype. This environment allows users to try out the prototype easily without any technical barriers.

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2. **Delivery:** The prototype is provided to users or stakeholders with clear documentation or instructions. This is intended to help users understand the context and limitations of the prototype and know which aspects to focus on during testing.
3. **Feedback Collection:** As users try out the prototype, the team receives important feedback to learn about their experiences and opinions about the prototype. This input can include functionality, ease of use, and whether the existing functionality meets needs.
4. **Evaluation and Analysis:** The team analyzes the feedback received to understand the strengths and weaknesses of the prototype. This includes identifying issues, suggesting improvements, and even potential new features that may have yet to be considered.
5. **Iteration and Refinement:** The team refined and changed the prototype based on the feedback. This includes feature enhancements, bug fixes, user interface improvements, or major revisions based on user needs.

This implementation, adoption, and feedback phase is critical with the prototype model because user feedback provides direct insight into how the product performs in real-world situations. This phase also helps the team ensure that subsequent iterations better meet user needs and move the prototype closer to the final version..

F. System Testing

Testing the document verification application system implementation is carried out to test the system functionality according to the previously designed scenario, and the software functionality is tested using black-box testing techniques.

Login testing, a critical part of our process, is a test that is specifically run on the login page. The tests carried out, including [specific tests], are shown in Table 1 below

Table 2. Login Testing

No	Inputan	Test Case	Expected Results	Test Results	Conclusion
1	Username	Blank	A warning must be filled in.	As expected	Received
		Fill in using characters other than letters and numbers	Receive input	As expected	Received
		Filled using email	Receive input	As expected	Received
		Filled in using characters other than letters, numbers and email	Displaying warning characters are allowed in letters, numbers, or emails	As expected	Received
		Fill in according to the original username.	The system receives input	As expected	Received
2	Password	Blank	A warning must be filled in.	As expected	Received
		Fill in using characters other than letters and numbers	It is permissible to display character warnings in the form of letters or numbers	As expected	Received
		Fill in exactly the same as the username	An incorrect username and password warning appears	As expected	Received
		Fill in the original password	The system receives input	As expected	Received

After testing the Data Processing Application Using QR Code and Black Box testing, a data processing application was produced that is easy to understand because it is designed to be user-friendly. Therefore, the Data Processing Application Using QR Code can help and be useful for the Company, especially admins and managers, to be more effective in using time so that the data processing process does not take too long.

DISCUSSIONS

Designing a good data processing app with QR code integration involves addressing several key considerations, from user experience to technical infrastructure. Some essential elements to discuss:

Purpose of the App

Understanding the purpose of the app is the foundation for its design. If the app is centred around QR code integration for data processing, consider the following: QR codes can encode various data types (URLs, product info, payment details, etc.)—scanning codes for retrieving information, payments, attendance tracking, etc.

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User Experience (UX)

The user interface must be intuitive and efficient for a data processing app to be effective. Here are some important considerations: The app should be able to scan codes quickly and accurately with minimal user effort. The interface should provide clear instructions for scanning and indicate when a scan is successful. After scanning, the app should give immediate feedback (success, failure, or next steps). In case of errors, such as an unrecognized or faulty QR code, it should guide users on what to do next. Depending on the app's use case, it should be able to store data offline and sync it once connectivity is restored.

Data Processing and Storage

Once a QR code is scanned, the data must be processed efficiently. This could involve converting it into meaningful information (like redirecting a user to a website, extracting stored product details, or triggering certain app functions). Ensure that sensitive information (especially when dealing with payment details, personal information, etc.) is encrypted and protected. QR codes can store sensitive data, so the app must ensure that this data is processed securely. Data processing apps often involve cloud integration to store and retrieve data. This allows for real-time access and updates across multiple users.

Designing the QR Code System

Static QR codes encode fixed information, whereas dynamic QR codes allow updating the stored data without changing the code itself. If the app generates QR codes (for instance, on receipts or product tags), their size and placement should be such that they can be easily scanned.

Security and Privacy

Encryption at rest and in transit is essential for sensitive data. Ensure that users are in control of how their data is processed. For instance, if the QR code contains personal data, the app should inform users and request necessary permissions.

A well-designed data processing app with QR code functionality requires careful consideration of user experience, security, data management, and integration capabilities. The app can provide a powerful tool for real-time data processing across various industries by focusing on fast scanning, robust security, and scalability. Ensuring the app is flexible, intuitive, and capable of handling diverse use cases will maximize its effectiveness and user satisfaction.

CONCLUSION

The testing and analysis showed that this application can collect and process data accurately from both simple and complex QR Code formats. Real-time data scanning and processing efficiency meet the expected standards and support a positive user experience. Overall, the design of the data processing application using the QR Code has achieved the main goals in terms of accuracy, efficiency, and user satisfaction. With continuous improvement and updates, this application can be a very effective tool in various industries that require fast and reliable data processing.

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