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Design of a Quick Response Code-based Infrastructure Management Information System

Moh. Sukron, M. Raihan Ramadhan, Ahmad Sihabillah
Universitas Nurul Jadid, Probolinggo, Indonesia

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ABSTRACT

The management of infrastructure and facilities at Madrasah Tsanawiyah (MTs) Mambaul Hasan Sumberrejo Paiton Probolinggo is currently conducted manually, resulting in significant issues such as data inaccuracies, misplacement of items, and difficulties in tracking asset movements. These challenges reduce efficiency and hinder effective inventory management. This research aims to design and develop a Quick Response (QR) Code-based management information system to enhance infrastructure and facilities management efficiency and effectiveness at MTs Mambaul Hasan. This research method is based on Research and Development (R&D) with a quantitative approach and a case study framework. The process includes system requirements analysis through direct observation and interviews with school staff, followed by system design using the Object-Oriented Analysis and Design (OOAD) approach. A prototype is then developed and tested to gather user feedback, and system evaluation is conducted to refine the system before full implementation. The results of this research are a QR Code-based infrastructure and facilities management information system that simplifies asset registration, enhances tracking accuracy, and reduces manual workload. Usability testing with school staff revealed an 82.67% satisfaction rate, indicating a significant improvement in efficiency and traceability of assets. Implementing this system provides a practical and effective solution for managing infrastructure and facilities at MTs Mambaul Hasan. This study concludes that the QR Code-based system improves inventory management efficiency, accuracy, and traceability. The implications of these findings suggest that other educational institutions can adopt similar technological solutions to modernize their management processes, with potential future integration of mobile and cloud technologies for enhanced usability and scalability.

Corresponding Author:

Moh. Sukron,
Universitas Nurul Jadid, Probolinggo, Indonesia,
Email: moh.sukron12012752@gmail.com

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1. INTRODUCTION

The management of infrastructure and facilities is crucial in supporting educational activities in schools. Effective management not only ensures optimal utilization of resources but also minimizes operational inefficiencies. At Madrasah Tsanawiyah (MTs) Mambaul Hasan Sumberrejo Paiton Probolinggo, infrastructure management is still performed manually, relying on physical ledgers or basic spreadsheets. This outdated approach results in various issues, such as errors in inventory records, difficulties in tracking the movement of assets, and challenges in detecting losses or damages. These inefficiencies hinder the institution's ability to maintain accurate, up-to-date records, negatively affecting resource planning and allocation. Numerous studies have attempted to address these issues by applying information systems. For example, research [1] developed a mobile-based inventory management system using Quick Response (QR) Code technology, as documented in their study, focusing on enhancing asset tracking and inventory accuracy. Ensure this reference aligns with the citation details in the bibliography and follows the appropriate citation format, enhancing asset tracking and inventory accuracy. Research [2] proposed a web-based information system for managing school facilities, as detailed in their study, emphasizing data accuracy and operational efficiency. Ensure this reference aligns with the details provided in the bibliography and follows the correct citation format. for managing school facilities, emphasizing data accuracy and operational efficiency. Research [3] designed a QR Code-based school asset management system as documented in their study, focusing on integrating the Last In, First Out (LIFO) method for optimal inventory management. Ensure this reference aligns with the details provided in the bibliography and follows the correct citation format. Integrating the Last In, First Out (LIFO) method for optimal inventory management. Research [4] utilized the Rapid Application Development (RAD) approach, as documented in their study, to create a QR Code-based inventory system tailored for educational institutions. Ensure this reference aligns with the details provided in the bibliography and follows the correct citation format. To create a QR Code-based inventory system tailored for educational institutions. Research [5] introduced a monitoring inventory system using QR Code scanners integrated with CodeIgniter frameworks for efficient data handling. Research [6] developed a QR Code-based public lighting damage reporting system to improve asset maintenance response times. Research [7] implemented QR Code technology in an inventory system for laboratory management, focusing on transparency and ease of access. Research [8] proposed a smart school infrastructure system using QR Code technology to optimize inventory workflows and data accuracy.

While these systems have contributed significantly to improving inventory and asset management, gaps remain in addressing the unique needs of secondary schools, particularly madrasahs. Existing research often focuses on isolated functionalities such as inventory management or asset tracking without integrating essential features like asset placement monitoring, movement tracking, and comprehensive QR Code implementation in a unified system. Furthermore, previous studies rarely address madrasahs' specific administrative and operational requirements, which differ significantly from those of other educational institutions. Despite these advancements, some gaps have not been resolved by previous research, namely the lack of integrated solutions specifically designed for secondary schools and particularly madrasahs. Existing studies often focus on isolated functions, such as inventory or asset tracking, without integrating key components like asset movement monitoring, placement tracking, and the comprehensive application of QR Code technology in a single system. Moreover, previous research rarely considers madrasah's unique administrative and operational requirements, which differ significantly from other educational institutions. The difference between this research and the previous one is the development of a holistic QR Code-based infrastructure management information system tailored to the unique needs of madrasahs. This study integrates multiple functionalities, including asset registration, item placement, movement tracking, and QR Code-based monitoring, in a unified system to address inefficiencies in infrastructure management.

This research aims to design, develop, and evaluate a QR Code-based management information system for MTs Mambaul Hasan Sumberrejo Paiton Probolinggo. This system seeks to address the inefficiencies of manual processes by improving data accuracy, enhancing operational transparency, and streamlining asset tracking. The study uses an R&D methodology, employing iterative testing and refinement based on user feedback to ensure the system's effectiveness and usability. The contributions of this research are twofold, namely: (1) Providing MTs Mambaul Hasan with an effective infrastructure management solution that can also serve as a model for other madrasahs and secondary schools; (2) Enriching the literature on the application of QR Code technology and integrated management systems in educational settings, particularly in secondary schools. By addressing the identified research gaps, this study aims to bridge the disconnect between traditional manual practices and modern technological solutions, ultimately advancing the educational sector's management of infrastructure and facilities.

2. RESEARCH METHOD

This study adopts a qualitative paradigm as it focuses on deeply understanding the challenges in managing infrastructure and facilities at MTs Mambaul Hasan Sumberrejo Paiton Probolinggo. A case study approach was chosen to explore the issues in-depth within the specific and unique context. Additionally, a quantitative approach is applied during the testing phase to assess the

effectiveness and efficiency of the developed system. The Rapid Application Development (RAD) method is used during the system development process, allowing for rapid iterations through user involvement during the design and testing phases [9]. The primary method used in this research is RAD. This method was chosen because it allows for fast and effective application development through iterative design and testing cycles. The system design model employs an Entity Relationship Diagram (ERD) to design the database structure and a Data Flow Diagram (DFD) to represent the system's requirements, including activity diagrams and workflow diagrams. The research consists of several stages. First, problem analysis and needs assessment are conducted to identify the issues in infrastructure and facilities management. Data is collected through in-depth interviews with relevant stakeholders, such as the headmaster, facility staff, and teachers. In addition, supporting documents, such as school inventory reports, are also reviewed in detail. The next stage is system design, where the database structure and user interface are designed using appropriate methods. This process involves creating an ERD to represent the data structure and DFD to visualize the system workflow. After the design phase, the system is developed using the RAD method, which includes planning, prototyping, development, and iterative testing. Several software tools and platforms were used for system development. The system was built using the CodeIgniter 3 framework with MySQL as the database. The QR Code feature was also created using a PHP-based QR Code library. System testing uses a black-box testing approach to ensure that all system functions meet user requirements [10]. The final stage involves system testing and evaluation using a black-box testing approach to ensure that all core features function properly. Additionally, user acceptance testing (UAT) is carried out with end users, such as facility staff and the headmaster, to evaluate whether the system meets their needs. System testing is performed in two main phases. First, black-box testing ensures that every application function, such as QR Code generation, asset logging, and asset movement tracking, works properly. Second, UAT is conducted with users, such as the headmaster and facility staff, to evaluate the system's suitability to user needs [10–14].

3. RESULT AND ANALYSIS

The findings of this study are successful in developing a QR Code-based infrastructure management information system has proven to be an effective tool in streamlining the management of school infrastructure at MTs Mambaul Hasan Sumberrejo Paiton Probolinggo. The system successfully addressed key challenges faced in manual inventory management, such as difficulty in tracking assets, time-consuming data retrieval, and human errors during data entry.

3.1. System Design

Figure 1 is a flowchart that illustrates the process flow from item placement to the generation of QR codes based on the inventory codes used at MTs Mambaul Hasan Sumberrejo Paiton Probolinggo. This context diagram illustrates the scope of the system. Figure 2 shows the overall design of the QR code system based on the inventory codes used at MTs Mambaul Hasan Sumberrejo Paiton Probolinggo. An Entity Relationship Diagram (ERD) is a model that explains the relationships between data in a database based on the basic data objects with relational connections. ERD is used to model the data structure and relationships between data, and several notations and symbols are employed to represent these relationships, as shown in Figure 3.

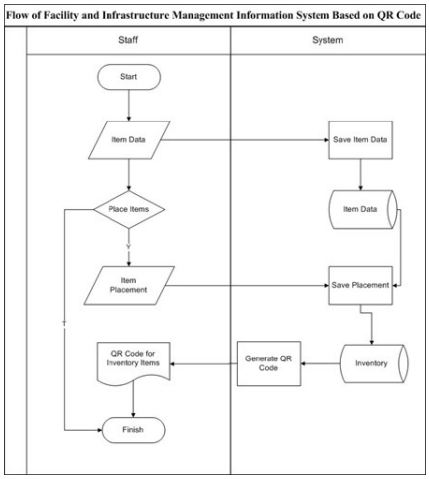

Figure 1. Flowchart

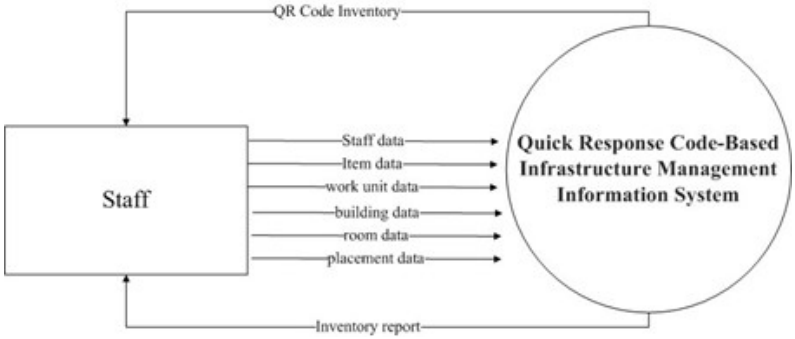

Figure 2. DFD

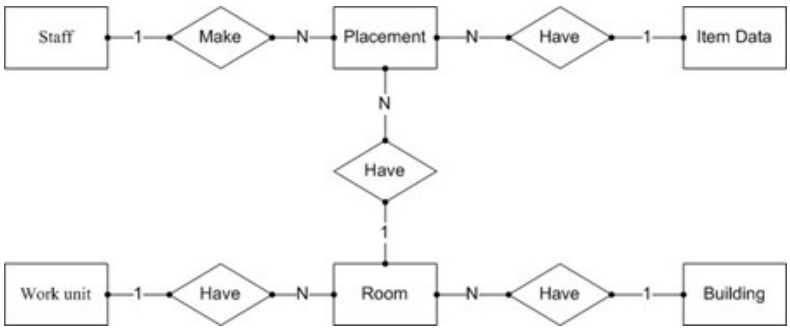

Figure 3. ERD

3.2. Implementation

The Login Page displays the login interface for the QR Code-based Infrastructure Management information system implemented at MTs Mambaul Hasan Sumberrejo Paiton Probolinggo. This page has a simple and intuitive interface to facilitate user access in using the system, particularly for the infrastructure staff. Users are required to enter their registered credentials, including a username and password, to ensure the security and privacy of the data. The page also includes a ”Forgot Password” option to assist with account recovery if users encounter difficulties accessing the system. Figure 4 shows that login page design is a crucial step in ensuring that only authorized users can access and manage inventory data within the school environment.

Figure 4. Login Page

Figure 5 is the dashboard page that displays the main dashboard of the QR Code-based Infrastructure Management information system implemented at MTs Mambaul Hasan Sumberrejo Paiton Probolinggo. This dashboard serves as the central control hub, providing the user a concise and structured presentation of essential information. Users can easily access key system features through the dashboard, such as managing item data, tracking item mutations, and generating inventory reports. The displayed information includes item data summaries, placement status, and recent activities related to infrastructure management. The dashboard design is user-friendly, featuring a clear interface and easy navigation, making it convenient for users to manage and monitor infrastructure status in real-time. Figure 6 is the item data Entry page that presents the data entry interface for the QR Code-based Infrastructure Management Information System at MTs Mambaul Hasan Sumberrejo Paiton Probolinggo. This page is designed to assist users, particularly the infrastructure staff, in digitizing the data entry and recording of items. Users can input various details related to the items on this page, such as the item name, inventory code, placement location, item condition, and other relevant information. Additionally, this feature allows users to generate QR codes directly that will be used to identify unique items. The page interface is designed to be simple yet functional, featuring a clear input form and easy-to-understand instructions, which help streamline the data entry process and reduce the risk of recording errors.

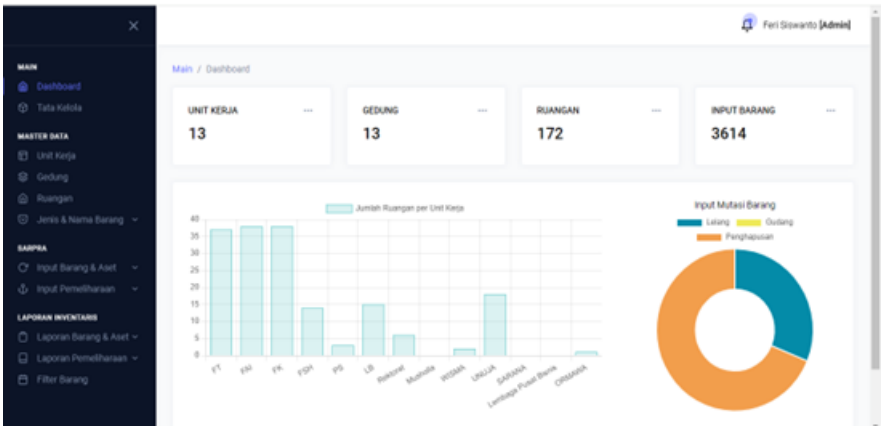

Figure 5. Dashboard Page

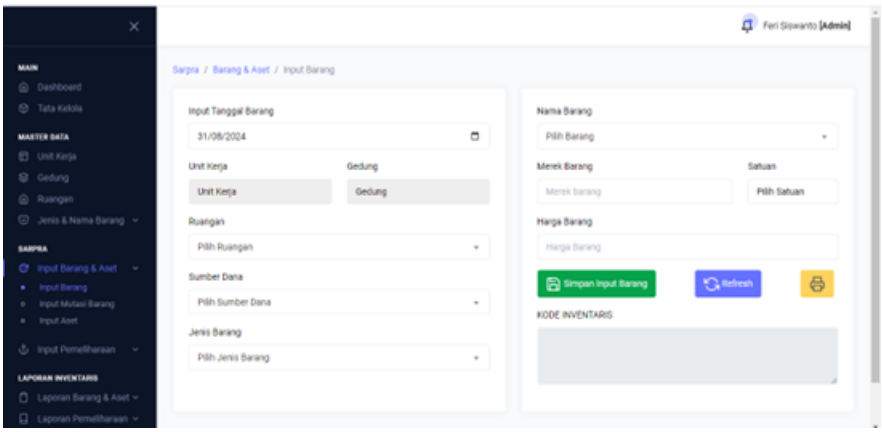

Figure 6. Item Data Entry Page

Figure 7 is the item data summary page that displays the summary of item data from the QR Code-based Infrastructure Management Information System at MTs Mambaul Hasan Sumberrejo Paiton Probolinggo. This page provides a comprehensive overview of all the items registered in the system. Each entry includes essential information such as the item name, inventory code, placement location, item condition, and the associated QR Code. This summary page is designed to help users efficiently monitor and manage the school's inventory, allowing them to locate and review the status of specific items quickly. The search and

sorting features available on this page also enable users to access specific information easily, improving the speed and accuracy of infrastructure management. These codes can then be printed and attached to the corresponding items, which ensures that each asset can be easily identified and tracked. The printing function was tested under various conditions, and it worked flawlessly, with the QR Codes (Figure 8) being printed clearly and accurately on standard paper.

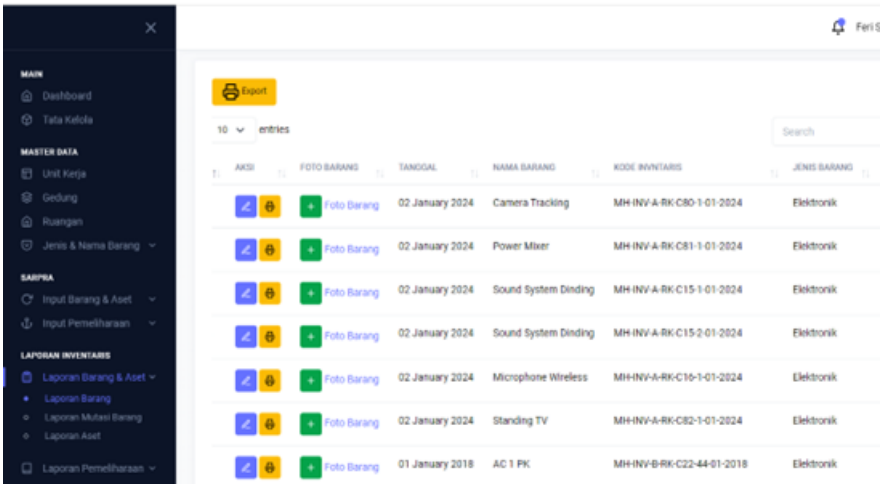

Figure 7. The Item Data Summary Page

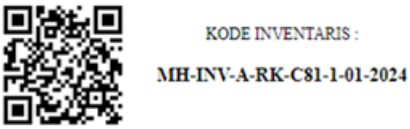

Figure 8. QR Code

3.3. Test Results from the Developed Application

The developed QR Code-based Infrastructure Management Information System has been tested to ensure that all components function as expected and meet the operational needs of MTs Mambaul Hasan Sumberrejo Paiton Probolinggo. The application's user interface (UI) was tested for usability by the staff using the system daily. The feedback received was largely positive, with users noting that the interface was intuitive, easy to navigate, and met their needs for managing the school's inventory. The login page, dashboard, and item entry pages were tested thoroughly for ease of use, and the results indicated a significant improvement in the time taken to perform these tasks compared to the previous manual methods. Based on the percentage results obtained in Table 1, it can be concluded that the feedback from infrastructure staff regarding the ease of use of the QR Code-based infrastructure management information System shows that 82.67% of respondents agreed or strongly agreed. This indicates that the system is considered effective and helps facilitate infrastructure and facilities management at MTs Mambaul Hasan. The use of QR Codes in infrastructure management information systems can make it easier to manage infrastructure. This is in line with research [15, 16].

Table 1. The Testing Results for the QR Code-Based Infrastructure Management Information System

Response Category	Staff Response Frequency	Score	Total Score
Strongly Agree	10	5	5x10=50
Agree	15	4	15x4=60
Disagree Slightly	4	3	4x3=12
Disagree	1	2	1x2=2
Strongly Disagree	0	1	0x1=0
			124

4. CONCLUSION

The conclusion of this research demonstrates that implementing the QR Code-Based Infrastructure Management Information System at MTs Mambaul Hasan Sumberrejo Paiton Probolinggo has successfully enhanced efficiency, accuracy, and transparency in managing the school's inventory and infrastructure. UAT results revealed a high satisfaction rate of 82.67% among staff, indicating that the system effectively addressed key challenges such as data entry errors, inefficient tracking of assets, and time-consuming manual processes. Features like QR Code generation, scanning functionality, and inventory reporting tools played a significant role in achieving these improvements. The results of this research suggest that the adoption of QR Code technology is highly suitable for infrastructure and asset management needs in educational institutions, offering a reliable and scalable solution for similar operational challenges. Moreover, this system not only provides practical benefits for MTs Mambaul Hasan but also has the potential to serve as a replicable model for other schools facing comparable infrastructure management issues.

However, it is important to acknowledge certain limitations, such as technological infrastructure constraints and the initial skill gaps among staff, which must be addressed to optimize the system's potential fully. Therefore, it is recommended that continuous improvements to the technological infrastructure be invested in, and ongoing training for staff members should be provided to ensure the long-term sustainability and effectiveness of the system. This research also opens up opportunities for future studies, particularly in exploring advanced features tailored to specific school needs, as well as conducting long-term evaluations to measure the system's impact on operational efficiency, educational service quality, and overall institutional performance.

5. ACKNOWLEDGEMENTS

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REFERENCES

[1] S. Kar, S. Bhimrajka, A. Kumar, and S. Mukherjee, "Mobile based Inventory Management System with QR code," in *2022 IEEE International Conference on Electronics, Computing and Communication Technologies (CONECCT)*. IEEE, pp. 1–6. [Online]. Available: https://ieeexplore.ieee.org/document/9865739/

[2] A. P. Hesti, D. Krisbiantoro, and B. A. Kusuma, "Sistem Informasi Sarana dan Prasarana Sekolah Berbasis Website SMK Bakti Purwokerto," vol. 2, no. 1, pp. 33–42. [Online]. Available: https://jurnal.amikom.ac.id/index.php/joism/article/view/211

[3] M. T. M. Aksan and E. Andika, "Perancangan sistem informasi manajemen aset sekolah menggunakan metode lifo dan qr code berbasis website," vol. 5, no. 0, pp. 446–450. [Online]. Available: https://semnastera.polteksmi.ac.id/index.php/semnastera/article/view/681

[4] R. D. Kurniawan, D. F. Fahirah, and G. Gunawan, "Penerapan QR-code untuk Aplikasi Inventaris dengan Metode Rapid Application Development," vol. 6, no. 4, pp. 2614–2620. [Online]. Available: http://journal.universitaspahlawan.ac.id/index.php/jrpp/article/view/21520

[5] M. N. Amin, "Penerapan Framework Codeigniter pada Pengembangan Aplikasi Perpustakaan Berbasis Website di SMP Negeri 2 Belik," vol. 1, no. 5, pp. 11–20. [Online]. Available: https://ejournal.warunayama.org/index.php/kohesi/article/view/163

[6] R. M. Hamzah, S. Maryana, and I. Anggraeni, "Layanan Pengaduan Kerusakan Penerangan Jalan Umum Menggunakan Kode QR dan Chat Otomatis Dinas Perhubungan," vol. 12, no. 1, pp. 29–43. [Online]. Available: https://ejurnal.undana.ac.id/index.php/jicon/article/view/9813

[7] N. Nirsal, S. Bantun, J. Y. Sari, A. N. M. Auliani, and M. Syaiful, "Implementasi Quick Response Code pada Aplikasi Series (Sistem Informasi Inventaris) Lab Terpadu USN Kolaka," vol. 8, no. 1, p. 17. [Online]. Available: http://ojs.uho.ac.id/index.php/semantik/article/view/25529

[8] G. A. Supriatmaja, I. P. M. Y. Pratama, K. Mahendra, K. D. D. Widyaputra, J. Deva, and G. S. Mahendra, "Sistem Informasi Perpustakaan Menggunakan Framework Bootstrap dengan PHP Native dan Database MySQL Berbasis Web pada SMP Negeri 2 Dawan," vol. 1, no. 1, pp. 7–15. [Online]. Available: https://ejurnal.bangunharapanbangsa.id/index.php/jtik/article/view/31

[9] M. T. Parinsi, A. Mewengkang, and T. Rantung, "Perancangan Sistem Informasi Sekolah di Sekolah Menengah Kejuruan," vol. 1, no. 3, pp. 227–240. [Online]. Available: https://ejurnal.unima.ac.id/index.php/edutik/article/view/1340

[10] S. Fadli and A. S. Pardiyansyah, "Sistem Informasi Sekolah dalam Penerapan Smart School untuk Meningkatakan Pelayanan Sekolah," vol. 5, no. 1, pp. 95–108. [Online]. Available: https://e-journal.stmiklombok.ac.id/index.php/misi/article/view/294

[11] H. P. Adi, "Application of Analytical Hierarchy Process (AHP) Method in Determining Dike Construction for Handling Tidal Flood," vol. 3, no. 1, p. 17. [Online]. Available: http://jurnal.unissula.ac.id/index.php/JACEE/article/view/8092

[12] I. Irwanto, "Perancangan Sistem Informasi Sekolah Kejuruan dengan Menggunakan Metode Waterfall (Studi Kasus SMK PGRI 1 Kota Serang-Banten)," vol. 12, no. 1, pp. 86–107. [Online]. Available: https://journal.unilak.ac.id/index.php/lectura/article/view/6093

[13] A. Duma and E. A. Pusvita, "Pengembangan Sistem Informasi Data Siswa Berbasis Web Pada SMPN 09 Nabire dengan Metode Waterfall," vol. 5, no. 1, pp. 70–76. [Online]. Available: https://jurnal.amikom.ac.id/index.php/joism/article/view/1115

[14] H. Hairani, L. Nurhayati, and M. Innuddin, "Web-Based Application for Toddler Nutrition Classification Using C4.5 Algorithm," vol. 1, no. 2, pp. 77–82. [Online]. Available: https://journal.universitasbumigora.ac.id/index.php/IJECSA/article/view/2387

[15] M. S. Lawalata, M. L. Kiet Tumiwa, H. Pesik, and E. S. A. Lumunon, "QR Code Labeling Design for Fixed Asset Management in Accounting Information System PT. Cipta Jaya Perkasa," vol. 15, no. 6, pp. 1–8. [Online]. Available: https://journal.ikopin.ac.id/index.php/covalue/article/view/4836

[16] G. De Seta, "QR code: The global making of an infrastructural gateway," vol. 8, no. 3, pp. 362–380. [Online]. Available: https://journals.sagepub.com/doi/10.1177/20594364231183618