VOL. 11. NO. 1 AUGUST 2025
P-ISSN: 2685-8223 | E-ISSN: 2527-4864
DOI: 10.33480 /jitk.v11i1.7009

JITK (JURNAL ILMU PENGETAHUAN DAN TEKNOLOGI KOMPUTER)

FACE DETECTION FOR ENTERPRISE RESOURCE PLATFORM ATTENDANCE SYSTEM: A COMPARATIVE ANALYSIS

Suwarno[1*]; Mangapul Siahaan[1]; Delvin Lim[1]

Information System[1]
Universitas Internasional Batam, Batam, Indonesia[1]
https://uib.ac.id/[1]
swliang@gmail.com*

(*) Corresponding Author
(Responsible for the Quality of Paper Content)

***Abstract**—The demand for face detection capabilities in attendance systems has led to various implementations using different algorithms and Enterprise Resource Planning (ERP) platforms. This research aimed to conduct a comparative analysis of three face detection algorithms—Dlib, Haar-Cascade, and MTCNN (Multi-task Cascaded Convolutional Networks)—and implement the most effective solution in an Odoo-based attendance system supporting multiple face detection. The study employed evaluation methodology analyzing real-time video streams, utilizing distinct datasets: a control dataset under standard conditions and a challenge dataset featuring variations in lighting, occlusions, and multiple simultaneous faces. Performance evaluation was based on true positive, false positive, and false negative rates for face detection across both datasets. Results demonstrated significant performance variations: under controller conditions, MTCNN achieved 99.69% detection accuracy compared to Dlib's 92.92% and Haar-Cascade's 84.08%, while in challenging environments, MTCNN maintained 60.93% accuracy versus Dlib's 0.66% and Haar-Cascade's 2.36%. The significant performance drop in challenging conditions can be attributed to poor lightning conditions, facial occlusions, and the complexity of detecting multiple faces simultaneously. The findings facilitated the development of a custom Odoo attendance module implementing MTCNN, demonstrating potential for improving automated attendance efficiency in organizations while establishing benchmarks for futher development of face recognition-based features within Odoo ERP.*

***Keywords**: algorithm comparison, attendance system, computer vision, face detection, odoo erp.*

Intisari— *Permintaan akan kemampuan deteksi wajah dalam sistem absensi telah mendorong berbagai implementasi dengan menggunakan algoritma yang berbeda dan platform Enterprise Resource Planning (ERP) yang beragam. Penelitian ini bertujuan untuk melakukan analisis komparatif terhadap tiga algoritma deteksi wajah—Dlib, Haar-Cascade, dan MTCNN (Multi-task Cascaded Convolutional Networks)—serta mengimplementasikan solusi paling efektif ke dalam sistem absensi berbasis Odoo yang mendukung deteksi wajah ganda. Studi ini menggunakan metodologi evaluasi dengan menganalisis aliran video secara real-time, menggunakan dua jenis dataset: dataset kontrol dengan kondisi standar, dan dataset tantangan yang mencakup variasi pencahayaan, halangan, serta kehadiran banyak wajah secara bersamaan. Evaluasi kinerja didasarkan pada tingkat true positive, false positive, dan false negative untuk deteksi wajah pada kedua dataset tersebut. Hasil penelitian menunjukkan variasi kinerja yang signifikan: dalam kondisi terkendali, MTCNN mencapai akurasi deteksi 99,69% dibandingkan dengan Dlib sebesar 92,92% dan Haar-Cascade sebesar 84,08%, sedangkan dalam lingkungan yang menantang, MTCNN mempertahankan akurasi 63,27% berbanding Dlib sebesar 0,66% dan Haar-Cascade sebesar 2,36%. Penurunan kinerja yang signifikan dalam kondisi menantang disebabkan oleh pencahayaan yang buruk, terhalangnya wajah, dan kesulitan mendeteksi beberapa wajah sekaligus. Temuan ini mendukung pengembangan modul absensi kustom di Odoo yang mengimplementasikan MTCNN, menunjukkan potensi untuk meningkatkan efisiensi absensi otomatis dalam*

Accredited Rank 2 (Sinta 2) based on the Decree of the Dirjen Penguatan RisBang Kemenristekdikti No.225/E/KPT/2022, December 07, 2022. Published by LPPM Universitas Nusa Mandiri

VOL. 11. NO. 1 AUGUST 2025
P-ISSN: 2685-8223 | E-ISSN: 2527-4864
DOI: 10.33480/jitk.v11i1.7009

organisasi sambil menetapkan tolok ukur untuk pengembangan lebih lanjut fitur pengenalan wajah dalam sistem ERP Odoo.

Kata Kunci: *komparasi algoritma, sistem kehadiran, computer vision, deteksi wajah, erp odoo.*

INTRODUCTION

In the current technological landscape, face detection stands out as a pivotal component with widespread implications [1]. Its significance spans from fortifying security protocols to revolutionizing user experiences in everyday devices [2], [3]. Face detection also serves as a foundational element for various facial analysis techniques, encompassing face localization, facial feature detection, face identification, face verification, and facial expression recognition [4]. Moreover, it constitutes a fundamental component in diverse technologies such as content-based image retrieval, video conferencing, and intelligent human-computer interaction (HCI) [5].

Among these applications, attendance management systems represent a critical area of interest. Approached by concerned users seeking a solution, researchers identified that these users currently lack and attendance system, a critical standard in the educational industries leading to chaotic record-keeping of attendance [6]. Users demand a system capable of simultaneously capturing multiple attendance entries in a single session. To address this challenge, there is a pressing need for an attendance system based on real-time computer vision processing, leading this into an attendance system management based on face recognition [7], [8]. The face detection component of this system should be capable of capturing users in the camera in large quantities to effectively manage attendance.

After careful analysis of user requirements, researchers opted to recommend Odoo as the initial framework for developing the attendance system. Odoo is an open-source Enterprise Resource Planning (ERP) system designed to enhance organizational performance for various institutions, including educational organizations [9]. As open-source software, Odoo allows developers to access and modify its source code, making it highly customizable for different organizational needs. Its open source flexibility present significant opportunities for integration with emerging technologies to enhance institutional operations and streamline administrative processes. Additionally, this choice aligns with user's expressed desire to establish an E-Learning management system that could be seamlessly integrated with the attendance system in the subsequent phases [10], [11], [12],

The development of such attendance system requires careful selection of appropriate face detection technologies. While numerous of face detection algorithms exist, the ones predominantly favored and widely acknowledged for their popularities usage on attendance system are Haar Cascade and HOG-SVM which built in to OpenCV and Dlib library [13], [14], [15], [16] However, in response to end user's requests for a computer vision algorithm capable of capturing a substantial number of individuals in a single view, our research have been realigned to explore alternative algorithms, leading us the exploration of MTCNN algorithm because of its capability [17], [18], [19], [20]. To determine which algorithm best meets the user needs, we conducted a comparison analysis of these algorithms.

The analysis of the algorithms is also driven by the necessity to discern the gap from previous studies which only conduct the analysis on single face detection [5]. This undertaking aims to empower users with insights, aiding them in selecting the most effective face detection solution tailored to diverse applications. As our digital environment continues to evolve [21], The efficiency and precision of face detection algorithms become not just technological imperatives but gateways to unlocking the full potential of contemporary innovations.

The integration of face detection algorithms with Odoo presents unique opportunities. while some research articles have explored the integration of face recognition with Odoo [22], these studies have been limited to specific algorithms. There is still untapped potential in fully exploring the integration of facial detection and recognition technology with Odoo. This innovative endeavor holds the promise of streamlining attendance tracking and potentially unlocing new dimensions of user interaction within the Odoo platform. As the intersection of face detection and Odoo remains largely unexplored, this study aims to shed light on the uncharted potentials, providing a pioneering understanding of how these technologies can harmoniously coexist in a business management context.

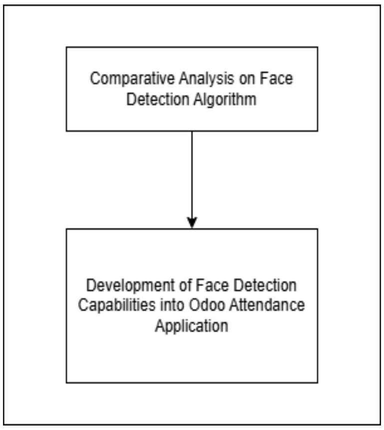
Therefore, this research is primarily focused on conducting an in-depth comparative analysis of the MTCNN, Haar Cascade, Dlib's HOG-SVM

VOL. 11. NO. 1 AUGUST 2025
P-ISSN: 2685-8223 | E-ISSN: 2527-4864
DOI: 10.33480 /jitk.v11i1.7009

algorithms. Following this comparative assessment, the objective is to develop an attendance application using the most effective algorithm identified within the Odoo framework. This study addressing the existing gap in previous studies and attendance management within Odoo application, also aspires to not only bridge practical challenges but also to contribute significantly to the academic and professional understanding of algorithmic comparisons.

MATERIALS AND METHODS

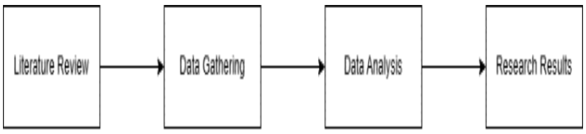
The methodology for this research comprises two interconnected stages: comparative analysis and application development. Similar flow that used by [23], as shown in Figure 1.



Source: (Research Results, 2025)
Figure 1. Research Flow

A Comparative Analysis

The comparative analysis is conducted to evaluate different face detection techniques, based on accuracy, processing speed, and robustness, using a standardized dataset. Performance metrics such as detection rate and false positive are used to assess techniques. The results of this analysis guide the selection of the most suitable method for the next phase. the comparative approach will draw upon the prior investigation conducted by [24] as illustrated in the Figure 2 that encompasses the journey from literature review into the final findings.



Source: (Research Results, 2025)
Figure 2. Comparative Analysis Flow

1 Literature Review

The literature review phase began with a systematic examination of previous studies and related articles in the field of face detection algorithms. This comprehensive review process provided essential insights into the current state of research, including various face detection approaches, their evolution, and recent developments in the field.

Based on the reviewed literature, the author identified and extracted key research elements that align with this study's objectives. These elements include established evaluation metrics, testing methodologies, and experimental parameters, which were carefully selected to ensure a robust framework for the comparative analysis of face detection algorithms.

2 Data Gathering

The datasets for this study are curated from YouTube videos, which are categorized into two distinct groups: 1 minute control video representing ideal conditions with total 1799 frame and 2 minute challenge video with total 2826 frame containing various complications. Each video clip was labelled manually using CVT AI tools to generate the bounding boxes, establishing the ground truth necessary for evaluating face detection algorithm performance [25].

3 Data Analyzing

The data obtained in the gathering phase undergoes systematic evaluation and analysis using established performance metrics. All analysis were conducted using Python programming language on system with AMD Ryzen 5 7535HS processor, 16GB RAM, and NVIDIA RTX 2050 graphics card. This study employs Intersection over Union (IOU), widely-adopted metrics method in object detection and face recognition. As established by [26], [27], [28] these metrics include correct detections, false detections, and missed detections, offering a thorough assessment of each algorithm's detection capabilities.

4 Research Results

The research findings are systematically presented based on the experimental analysis conducted on two video datasets: a control dataset under ideal conditions and a challenge dataset featuring real-world complications (varying lighting conditions, face angles, and occlusions in group dancing scenarios) [29], [30].

The primary analysis focuses on fundamental detection performance metrics derived from IOU calculations, specifically examining True Positive (TP), False Positive (FP), and False Negative (FN) rates across both datasets. From these confusion matrix values, precision, recall, and F1-score metrics are calculated to provide comprehensive performance evaluation. Processing speed, measured in Frame per Second (FPS), is evaluated

Accredited Rank 2 (Sinta 2) based on the Decree of the Dirjen Penguatan RisBang Kemenristekdikti No.225/E/KPT/2022, December 07, 2022. Published by LPPM Universitas Nusa Mandiri

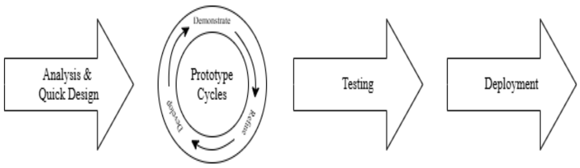
VOL. 11. NO. 1 AUGUST 2025
P-ISSN: 2685-8223 | E-ISSN: 2527-4864
DOI: 10.33480/jitk.v11i1.7009

to assess the algorithm's real-time performance capabilities and the results are presented in tabular format for clear comparison between datasets.

B Application Development

In the creation of an attendance system module, author adopts the SDLC (Software Development Life Cycle) framework, utilizing the Rapid Application Development (RAD) methodology for the development and integration of a face detection system within the Odoo platform. The combination of SDLC's structured approach with RAD's emphasis on rapid prototyping allows for a flexible yet systematic development process.

The decision to employ RAD stems from its proven success in projects involving rapid prototyping and iterative development with modular-based approach. Previous studies, such as those conducted by [31], [32], [33] demonstrated the efficacy of RAD in software applications that require swift integration of technologies. This methodology excels in maintaining adaptability to evolving technical requirements while supporting modular development practices.



Source: (Research Results, 2025)

Figure 3. RAD Diagram

As illustrated from Figure 3 above, the methodology employed in this study follows the framework delineated by [34], which articulates a systematic progression through Requirements Planning, Prototyping, Testing, and Deployment phases. [34] elucidates how the RAD methodology facilitates concurrent development and iterative refinement of system modules. This approach is particularly advantageous for the integration of complex algorithms, such as face detection, as it enables optimization for real-time performance and system scalability. The parallel development process inherent to RAD allows for continuous adjustment and improvement of individual components, thereby enhancing the overall system's efficiency and adaptability to evolving requirements.

1 Requirements Planning

In this initial phase, system requirements were defined, focusing on the integration of a facial recognition module with the existing Odoo architecture. Special attention was given to ensuring the system's scalability, ease of use, and alignment with Odoo's existing attendance workflows.

2 Prototyping and Development

Rapid prototyping enabled the author to develop and test several versions of the face detection system, iterating quickly based on test results. This approach also mirrors the work of [33], where continuous testing and refinements of the face detection model options led to enhanced detection accuracy and reduced false positives.

3 Testing

Once a stable prototype was developed, the testing phase commenced. The face detection algorithm was embedded into Odoo's attendance module, ensuring compatibility with existing functionalities such as attendance logging. This process also included comprehensive testing in live environments to ensure that the system could handle real-world variables such as lighting conditions, different facial angles, and user variability.

4 Deployment

After rigorous testing, the final version of the attendance system was deployed within the Odoo environment. Ongoing maintenance and fine-tuning are planned to ensure the system continues to meet performance benchmarks, with provisions for future updates to accommodate advancements in face detection technologies.

RESULTS AND DISCUSSION

A Algorithm Analysis

This study compares the performance of three prominent face detection algorithms: Dlib, Haar-Cascade, and Multi-task Cascaded Convolutional Networks (MTCNN) on multiple faces in frame. Our analysis, based on the methodology and metrics used by [5], [26], was conducted across two distinct type datasets. The evaluation reveals that MTCNN consistently outperforms both Dlib and Haar-Cascade across multiple evaluation metrics.

To evaluate each algorithm's performance comprehensively, author conducted an analysis that included measuring True Positive (TP) rates, False Positive (FP) rates, False Negative (FN) rates, and the processing speed in terms of Frame per Second (FPS). Table 1 presents the comprehensive performance of performance metrics obtained from testing all three algorithms across both controlled and challenge datasets.

Table 1. Algorithm Metrics

Method	Controlled						Challenge					
	Total Frame	Total Faces	TP	FP	FN	Avg FPS	Total Frame	Total Faces	TP	FP	FN	Avg FPS
Dlib [13]	1799	3600	3345	57	255	12	2826	9847	65	35	9782	14
Haar [35]	1799	3600	3027	912	573	18	2826	9847	232	352	9615	28
MTCNN [15]	1799	3600	3589	342	11	7	2826	9847	6000	1510	3847	11

Source: (Research Results, 2025)

Additionally, author calculated precision, recall, and F1-score to provide a comprehensive evaluation of algorithm performance. These metrics assessed the model's classification accuracy by measuring the proportion of correct positive predictions (precision), the ability to identify all actual positive cases (recall), and the harmonic mean of both measures (F1-score).

Table 2.Performance Metrics

Method	Controlled			Challenge		
	Precision	Recall	F1-score	Precision	Recall	F1-score
Dlib [13]	98.32%	92.92%	95.54%	65%	0.66%	1.31%
Haar [35]	76.85%	84.08%	80.30%	39.73%	2.36%	4.45%
MTCNN [15]	91.30%	99.69%	95.31%	79.89%	60.93%	69.14%

Source: (Research Results, 2025)

Analysis of the results reveals distinct performance patterns across both controlled and challenge datasets. Under controlled conditions with total 3600 faces, MTCNN demonstrated superior overall performance by correctly identifying 3589 faces, achieving detection rate (recall) of 99.69%, precision of 91.30%, and F1-score of 95.31%. The algorithm recorded 342 false detection and just 11 missed faces. While Dlib achieved the lowest 57 false detection, and Haar-Cascade showed the highest with 912 false detection, MTCNN's algorithm balanced performance under both distinct datasets established its reliability for accurate face detection.

When subjected to the challenge dataset dancing scenarios containing 9847 faces, MTCNN achieved 6,000 correct detections, resulting in 60.93% accuracy, precision of 79.89%, and F1-score of 69.14%. Although the algorithm successfully handled dynamic movements, varying face angles, and partial occlusions, it also recorded 1,510 false positives and missed 3,847 faces under these complex conditions. This performance degradation under complex conditions resulted from poor lighting, facial occlusions, and the complexity of detecting multiple faces simultaneously in dynamic group scenarios. Despite these limitations, MTCNN's performance remained significantly superior to the other evaluated algorithms.

Dlib's performance showed a stark contrast between datasets. In controlled conditions, it achieve reasonable metrics with 3345 correct detections, recording a precision of 98.32%, recall of 92.92%, and F1-score of 95.54%, with 57 false positives, and 255 missed detections. However, its performance degrades significantly in the challenge dataset, detected only 65 faces correctly with a drastically reduced precision of 65%, recall of 0.66%, and F1-score of 1.31%， while missing 9782 faces and generating 35 false detections. This significant decline highlight Dlib's algorithm limitations in handling dynamic scenarios.

The Haar-Cascade classifier consistently showed the lowest accuracy. Under controlled conditions, it detected 3027 faces correctly with a precision of 76.85%, recall of 84.08%, and F1-score of 80.30%, but generated 912 false positives and missed 573 faces. Its performance further degraded in the challenge dataset, achieving only a precision of 39.73%, recall of 2.36%, and F1-score of 4.45%, with just 232 correct detections, 352 false positives, and 9615 missed faces, demonstrating its vulnerability to complex backgrounds and varying lighting conditions.

The comprehensive analysis establishes MTCNN as the most robust solution across both scenarios, despite requiring more computational resources. While all algorithms showed some performance degradation in challenging conditions, MTCNN maintained significantly better accuracy, particularly with multiple faces and varying poses. This superior detection capability, however, comes with slower processing speeds—an important consideration for real-time applications.

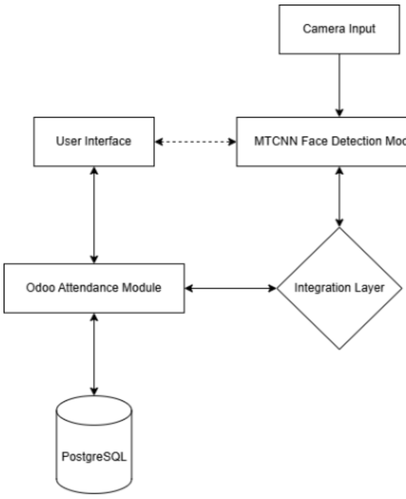
B Application Overview and Black Box Testing

Based on the comparative analysis, MTCNN algorithm emerged as the most robust face detection method among the three evaluated. This

VOL. 11. NO. 1 AUGUST 2025
P-ISSN: 2685-8223 | E-ISSN: 2527-4864
DOI: 10.33480/jitk.v11i1.7009

section details the integration of MTCNN with the Odoo attendance application, providing an overview of the system architecture, implementation process, and black box testing results.

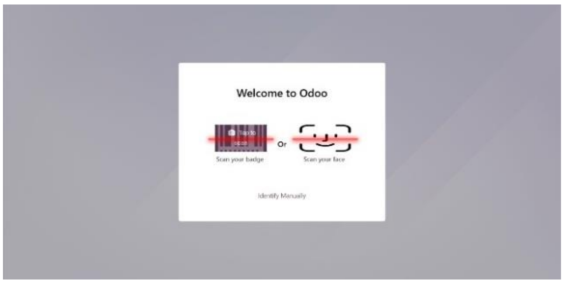
The integration of MTCNN with the Odoo attendance system aims to enhance the reliability of employee attendance tracking. Figure 4 presents the high-level architecture of the system.



Source: (Research Results, 2025)
Figure 4. System High-Level Architecture

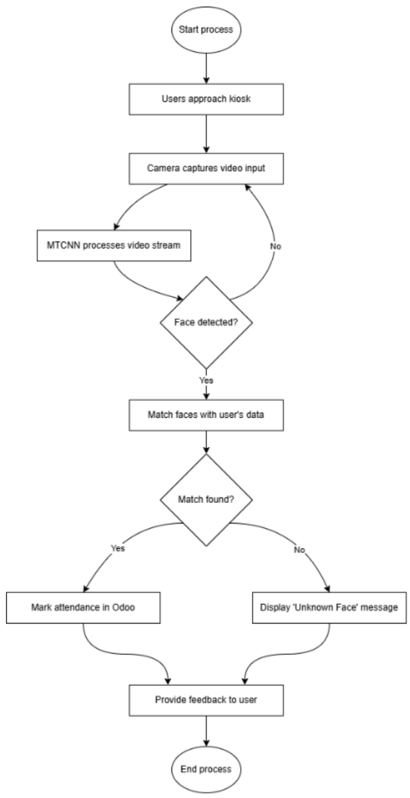
As illustrated in Figure 4, the integrated system comprises several key components: the MTCNN Face Detection Module, which utilizes the MTCNN algorithm to detect and localize faces in video streams from the attendance system's camera; the existing Odoo Attendance Module that manages attendance records and user interfaces; an Integration Layer that bridges the MTCNN module with the Odoo system, PostgreSQL; a Database that stores employee information, attendance records, and face recognition data; and a User Interface that provides access to attendance management features and real-time face detection feedback.

The integration process involved several key steps. First, we implemented the MTCNN algorithm using JavaScript. Next, the existing Odoo attendance module was modified to incorporate face detection capabilities. This includes addition field in employee table to store user's face descriptor and a custom web page using customized Odoo Web Library component to record user's face. A custom integration layer was developed to handle communication between the MTCNN module and the Odoo default system, managing tasks such as sending detection results to Odoo, triggering attendance actions. The Odoo interface was updated to include face detection feedback and new attendance marking options. Figure 5 showcases the overall user interface.



Source: (Research Results, 2025)
Figure 5. Kiosk Attendance User Interface

The integrated application follows a streamlined workflow for attendance marking. Users approach the attendance kiosk, then the system's camera captures video input. MTCNN processes the video stream in real-time to detect faces. Upon successful face detection, the system attempts to match the face with stored employee data. If a match is found, the attendance is automatically marked in the Odoo system, and the interface provides real-time feedback to the employee. Figure 6 illustrates this workflow in detail.



Source: (Research Results, 2025)
Figure 6. Application Flowchart

To ensure the reliability and accuracy of the integrated system, we conducted extensive black box testing. This testing focused on evaluating the system's performance from an end-user perspective [36] without considering the internal workings of the individual components. Table 3 present the results of the conducted black box testing.

Table 3. Black Box Testing

Test Case	Expected Results	Results
Navigate to the employee menu, select specific user's data, and click on register face button.	The webpage will open, and the system's camera will activate to capture webcam input. The system will then transmit facial descriptor data for each detected user.	Valid
Navigate to the attendance kiosk menu and click on barcode the image.	The default kiosk interface will initialize and begin detecting human faces. For each detected face, the system will display a labeled bounding box around it. If the face matches a registered user, the label will display the user's name; otherwise, it will display "Unknown".	Valid
Navigate to attendance menu, check user's attendances.	Attendance records from previously registered through the kiosk's face recognition system will be available.	Valid

Source: (Research Results, 2025)

CONCLUSION

This research aimed to evaluate three prominent face detection algorithms—Dlib, Haar-Cascade, and MTCNN—and implement the most optimal algorithm into an Odoo ERP for enhanced attendance management. Through comparative analysis across both distinct datasets, MTCNN demonstrated superior performance with higher detection up to 99.69% on controlled conditions and 60.93% in challenging environment.

Based on these findings, MTCNN algorithm was successfully integrated into the Odoo ERP platform, resulting in a robust attendance management solution. This implementation effectively bridges the gap between previous research algorithm comparison performance on multiple faces detection scenario and practical business applications, providing a reliable automated attendance management system that processes video-based face detection. Future research directions could explore model optimizations for improved performance in challenging conditions, developing a configurable system that allows users to select appropriate algorithms based on their specific scenarios—such as utilizing Dlib for single-face detection environments where precision is prioritized—and exploring hybrid approaches that combine the strengths of multiple detection algorithms for enhanced overall system performance.

REFERENCE

[1] M. K. Hasan, M. S. Ahsan, Abdullah-Al-Mamun, S. H. S. Newaz, and G. M. Lee, "Human face detection techniques: A comprehensive review and future research directions," *Electronics (Switzerland)*, vol. 10, no. 19, Oct. 2021, doi: 10.3390/electronics10192354.

[2] Y. Zhong, S. Oh, and H. C. Moon, "Service transformation under industry 4.0: Investigating acceptance of facial recognition payment through an extended technology acceptance model," *Technol Soc*, vol. 64, Feb. 2021, doi: 10.1016/j.techsoc.2020.101515.

[3] Y. Yusmanto, H. Ar Rosyid, and A. Prasetya Wibawa, "Design and development of face recognition-based security system using expression game as liveness detection," *Bulletin of Social Informatics Theory and Application*, vol. 8, no. 2, pp. 280–294, Dec. 2024, doi: 10.31763/businta.v8i2.756.

[4] H. T. Ho, L. Vuong Nguyen, T. Le Thi Huong, and O. J. Lee, "Face Detection Using Eigenfaces: A Comprehensive Review," 2024, *Institute of Electrical and Electronics Engineers Inc.* doi: 10.1109/ACCESS.2024.3435964.

[5] N. Singh and R. M. Brisilla, "Comparison Analysis of Different Face Detecting Techniques," in *3rd IEEE International Virtual Conference on Innovations in Power and Advanced Computing Technologies, i-PACT 2021*, Institute of Electrical and Electronics Engineers Inc., 2021. doi: 10.1109/i-PACT52855.2021.9696583.

[6] N. S. Ali, A. H. Alhilali, H. D. Rjeib, H. Alsharqi, and B. Al-Sadawi, "Automated attendance management systems: systematic literature review," 2022, *Inderscience Publishers*. doi: 10.1504/IJTEL.2022.120559.

[7] E. Jain and S. Mishra, "Face Recognition Attendance System based on Real-Time Video," *Int J Comput Appl*, vol. 184, no. 6, pp. 12–18, Apr. 2022, doi: 10.5120/ijca2022921983.

[8] T. V. Dang, "Smart Attendance System based on Improved Facial Recognition," *Journal of Robotics and Control (JRC)*, vol. 4, no. 1, pp. 46–53, Jan. 2023, doi: 10.18196/jrc.v4i1.16808.

[9] V. Chin and H. Lukman, "Evaluasi Pelaporan Keuangan Sistem ERP Odoo Community yang Dikembangkan PT Neo Multi Servindo," *Jurnal Ekonomi*, vol. 27, no. 3, pp. 224–241,

VOL. 11. NO. 1 AUGUST 2025
P-ISSN: 2685-8223 | E-ISSN: 2527-4864
DOI: 10.33480/jitk.v11i1.7009

2022, doi: https://doi.org/10.24912/je.v27i03.874.

[10] K. N. Mefid and A. I. Ahlunnazak, "Odoo-ERP as a Solution to Business Performance in Supply Chain of the Coffee Industry: A Systematic Literature Review," *Jurnal Manajemen Strategi dan Simulasi Bisnis (JMASSBI)*, vol. 4, no. 2, pp. 69–81, 2023, doi: https://doi.org/10.25077/mssb.4.2.69-81.2023.

[11] M. Siahaan, "Perancangan Enterprise Architecture Sistem Informasi Menggunakan Framework TOGAF ADM 9.2 PT. XYZ," *Jurnal Sisfokom (Sistem Informasi dan Komputer)*, vol. 10, no. 1, pp. 141–149, Apr. 2021, doi: 10.32736/sisfokom.v10i1.1087.

[12] H. Fatoni Efendi and A. Aditya, "Business Process Analysis and Implementation of Odoo Open Source ERP System in Inventory, Purchasing and Sales Activities (Case Study: Captain Gadget Store)," 2022. [Online]. Available: https://pssh.umsida.ac.id.

[13] S. Reddy Boyapally, "Facial Recognition and Attendance System using Dlib and Face Recognition Libraries," *International Research Journal of Modernization in Engineering Technology and Science*, pp. 409–417, 2021, Accessed: Jul. 13, 2025. [Online]. Available: SSRN 3804334

[14] T. Tan, H. Sama, G. Wijaya, and O. E. Aboagye, "Studi Perbandingan Deteksi Intrusi Jaringan Menggunakan Machine Learning: (Metode SVM dan ANN) Comparative Study of Network Intrusion Detection Using Machine Learning: (SVM and ANN Method)," vol. 13, 2023, doi: 10.34010/jati.v13i2.

[15] Ubong David Essien and Godwin Okon Ansa, "A deep learning-based face recognition attendance system," *Global Journal of Engineering and Technology Advances*, vol. 17, no. 1, pp. 009–022, Oct. 2023, doi: 10.30574/gjeta.2023.17.1.0165.

[16] R. Bairagi, R. Ahmed, S. A. Tisha, M. S. Sarder, M. S. Islam, and M. A. Islam, "A Real-time Face Recognition Smart Attendance System with Haar Cascade Classifiers," in *Proceedings of the 3rd International Conference on Inventive Research in Computing Applications, ICIRCA 2021*, Institute of Electrical and Electronics Engineers Inc., Sep. 2021, pp. 1417–1425. doi: 10.1109/ICIRCA51532.2021.9544872.

[17] P. Venkateswara Rao, G. S. Ramesh, S. Rashmitha, and A. Professor, "Real-Time Multiple Face Detection using MTCNN," *Industrial Engineering Journal*, vol. 52, no. 8, pp. 305–320, 2023.

[18] H. Ge, Y. Dai, Z. Zhu, and B. Wang, "Robust face recognition based on multi-task convolutional neural network," *Mathematical Biosciences and Engineering*, vol. 18, no. 5, pp. 6638–6651, 2021, doi: 10.3934/mbe.2021329.

[19] S. Singh Oberoi, "Facial Feature Detection in Real-Time: A Novel Approach with MTCNN Deep Learning," *Int. J. Advanced Networking and Applications*, vol. 15, no. 4, pp. 6076–6081, 2023.

[20] J. Yuan, P. Barmpoutis, and T. Stathaki, "Pedestrian Detection Using Integrated Aggregate Channel Features and Multitask Cascaded Convolutional Neural-Network-Based Face Detectors," *Sensors*, vol. 22, no. 9, May 2022, doi: 10.3390/s22093568.

[21] A. K. Feroz, H. Zo, and A. Chiravuri, "Digital transformation and environmental sustainability: A review and research agenda," *Sustainability (Switzerland)*, vol. 13, no. 3, pp. 1–20, Feb. 2021, doi: 10.3390/su13031530.

[22] Y. G. Sungkur, A. M. S. Ozeer, and S. D. Nagowah, "Development of an IoT-enabled Smart Library System for a University Campus," *Journal of Telecommunication, Electronic and Computer Engineering (JTEC)*, vol. 13, no. 1, pp. 27–36, 2021.

[23] S. Liang and Y. Hartanto, "Implementasi Bug Tracking System dengan Metodologi Scrum dan Algoritma Cosine Similarity," *JURIKOM (Jurnal Riset Komputer)*, vol. 9, no. 1, p. 24, Feb. 2022, doi: 10.30865/jurikom.v9i1.3861.

[24] Suwarno, Y. Christian, K. Yoputra, and Y. Estrada, "Exploring Machine Learning to Support Software Managers' Insights on Software Developer Productivity," *Journal of Applied Data Sciences*, vol. 6, no. 3, pp. 1504–1524, Sep. 2025, doi: 10.47738/jads.v6i3.661.

[25] R. Padilla, W. L. Passos, T. L. B. Dias, S. L. Netto, and E. A. B. Da Silva, "A comparative analysis of object detection metrics with a companion open-source toolkit," *Electronics (Switzerland)*, vol. 10, no. 3, pp. 1–28, Feb. 2021, doi: 10.3390/electronics10030279.

[26] L. Jiao *et al.*, "New Generation Deep Learning for Video Object Detection: A Survey," *IEEE Trans Neural Netw Learn Syst*, vol. 33, no. 8, pp. 3195–3215, Aug. 2022, doi: 10.1109/TNNLS.2021.3053249.

[27] H. Peng and S. Yu, "A Systematic IoU-Related Method: Beyond Simplified Regression for Better Localization," *IEEE Transactions on Image Processing*, vol. 30, pp. 5032–5044, 2021, doi: 10.1109/TIP.2021.3077144.

[28] M. Ahmed, K. A. Hashmi, A. Pagani, M. Liwicki, D. Stricker, and M. Z. Afzal, "Survey and performance analysis of deep learning based object detection in challenging environments," Aug. 01, 2021, *MDPI AG*. doi: 10.3390/s21155116.

[29] W. Ali, W. Tian, S. U. Din, D. Iradukunda, and A. A. Khan, "Classical and modern face recognition approaches: a complete review," *Multimed Tools Appl*, vol. 80, no. 3, pp. 4825–4880, Jan. 2021, doi: 10.1007/s11042-020-09850-1.

[30] H. L. Gururaj, B. C. Soundarya, S. Priya, J. Shreyas, and F. Flammini, "A Comprehensive Review of Face Recognition Techniques, Trends, and Challenges," *IEEE Access*, vol. 12, pp. 107903–107926, 2024, doi: 10.1109/ACCESS.2024.3424933.

[31] A. Dzaki Hernindyaputra, M. E. Johan, and D. Tjahjana, "Integrated System Design Of Sales And Production Module Using RAD Method (Case Study: PT Shafira Putri Kreatif)," *International Journal of New Media Technology)*, vol. 10, no. 1, 2023, doi: https://doi.org/10.31937/ijnmt.v10i1.3012.

[32] M. R. G. Qowindra and J. Wiratama, "Development of Enterprise Resource Planning (ERP) using the Rapid Application Development (RAD) Method for the Garment Industry in Indonesia," *G-Tech: Jurnal Teknologi Terapan*, vol. 7, no. 2, pp. 504–513, Mar. 2023, doi: 10.33379/gtech.v7i2.2296.

[33] Y. A. Singgalen, "Implementation of Rapid Application Development (RAD) for Community-based Ecotourism Monitoring System," *Journal of Information System Research (JOSH)*, vol. 5, no. 2, pp. 520–530, Jan. 2024, doi: 10.47065/josh.v5i2.4749.

[34] M. F. T. Nugraha, A. Kusnadi, and F. A. T. Tobing, "Implementation of the Rapid Application Method Development (RAD) in Clothes Sale Website Design," *Engineering and Technology Quarterly Reviews*, vol. 6, no. 2, pp. 10–18, 2023.

[35] F. M. Javed *et al.*, "Human Face Recognition Applying Haar Cascade Classifier 'Image Processing Based Human Face Recognition Using Haar Cascade Classifier' Image Processing Based Human Face Recognition Using Haar Cascade Classifier. Pre-Print," 2021.

[36] M. F. I. Khan, F. U. Mahmud, and A. Hoseen, "A New Approach of Software Test Automation using AI," *Journal Of Basic Science And Engineering*, vol. 21, no. 1, pp. 559–570, 2024.