Implementation of Modified MVC Model with Integrated Security in E-Procurement Application for Companies

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ABSTRACT

This research discusses the implementation of a modified MVC (Model-View-Controller) model combined with advanced security features in an e-procurement application. The main objective of this study is to enhance both efficiency and security in the electronic procurement of goods and services. The proposed modification not only separates application logic, user interface, and database layers but also integrates critical security mechanisms, particularly in the areas of data validation, encryption, and user authentication. By applying these additional layers of protection, the system aims to minimise unauthorised access, prevent data breaches, and ensure the integrity of transactional information. The implementation results indicate that the developed e-procurement application is capable of accelerating transaction processes, maintaining data confidentiality, and significantly reducing the risk of system misuse or fraudulent activities. Furthermore, the approach supports compliance with best practices in secure software development. Therefore, the modified MVC model with integrated security features can be regarded as an effective and reliable solution to foster transparency, operational efficiency, and trustworthiness in modern electronic procurement systems.

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1. INTRODUCTION

The rapid growth of information technology has encouraged companies to digitize procurement processes to achieve greater efficiency and transparency. E-procurement applications have become essential tools to manage supplier selection, bidding, and purchasing activities [1], [2].

However, security remains a significant concern in procurement systems, as sensitive data such as financial transactions, vendor information, and contracts are at risk of unauthorized access and cyberattacks [3], [4]. Conventional MVC (Model-View-Controller) frameworks provide modularity and scalability but lack sufficient security integration by default [5], [6].

Several previous studies have proposed security-enhanced MVC models [7], [8], but these approaches often suffer from complexity or limited adaptability. To address these challenges, this research modifies the MVC model by embedding security modules—authentication, encryption, and access control—into the architecture.

The contributions of this study include:

1. Designing a modified MVC architecture with integrated security modules.
2. Implementing the system in a corporate e-procurement application.
3. Validating the system through testing in terms of performance, security, and usability.

The rapid development of information and communication technology (ICT) has significantly influenced human life in various aspects [3], [14], [25]. Among these innovations, the Internet of Things (IoT) plays a vital role by connecting devices to the internet, enabling data exchange, automation, and intelligent control [4], [22].

In the area of SmartHome applications, IoT technology offers major benefits in terms of convenience, energy efficiency, and particularly home security [3], [12]. Traditional systems, such as [contoh dari skripsi], have several limitations, including [kekurangan yang disebutkan]. This creates a need for more intelligent systems that not only provide notifications but also interactive control and real-time monitoring [7], [9].
Previous studies have implemented ESP32-CAM for surveillance and facial recognition [1], [2], [5]. Others integrated IoT with mobile apps for real-time notifications [8], [21]. However, most of these approaches remain limited, focusing only on sending alerts without interactive feedback [16], [17].
This research addresses the gap by proposing [penjelasan singkat tujuan penelitian Ade Pratiwi]. The contributions of this work include:

1. Development of a [nama sistem] using
2. Integration of [hardware/software] with
3. Validation of system performance through

2. METHOD

The research methodology is divided into several stages: system design, hardware implementation, software development, and testing.

2.1 System Design

The proposed system architecture integrates [alat utama: ESP32, sensor, modul]. The workflow involves [alur sistem].

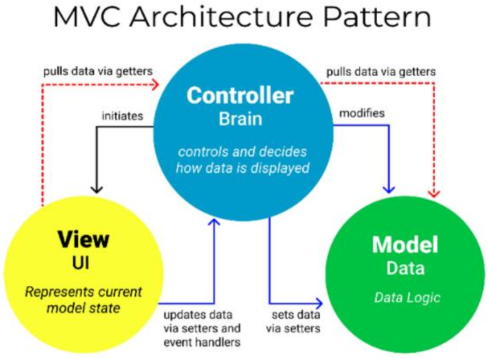


Figure 1 : System Block Diagram

2.2 System Implementation

1. Backend: Implemented using Laravel (PHP) with MySQL as the relational database.
2. Frontend: Built using Blade Template Engine, HTML, CSS, and JavaScript to provide interactivity.
3. Security: Passwords were encrypted with hashing (bcrypt), while an additional layer of face recognition authentication was integrated to strengthen user verification.

2.3 Integrasi Autentikasi Biometrik

The face recognition module was developed based on Convolutional Neural Networks (CNN). The workflow consisted of:

1. *Face Detection*: Locating the user’s face in an image using bounding boxes.
2. *Feature Extraction*: Analyzing facial geometry and texture to extract unique biometric traits.
3. *Faceprint Creation*: Converting extracted features into a numerical vector (digital faceprint).
4. *Matching*: Comparing new inputs against stored templates in the database. This approach was selected due to its high accuracy and usability, offering a frictionless login experience compared to traditional passwords.

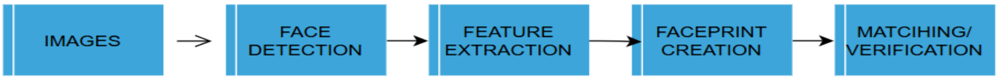


Figure 2 : Face Recognition Process

2.4 System Testing

The system was validated through two testing approaches:

1. Functional Testing: Using *black-box testing* to ensure modules (registration, login, procurement submission, verification) operated as expected.
2. Security Testing: Comparing authentication performance between password-based login and face recognition. This evaluation referred to the Authentication Method Comparative Table, highlighting the superiority of biometric authentication in terms of both security and user experience.
3. By following this methodology, the research ensured that the resulting e-procurement system was not only functionally reliable, but also significantly enhanced in terms of security, efficiency, and transparency.

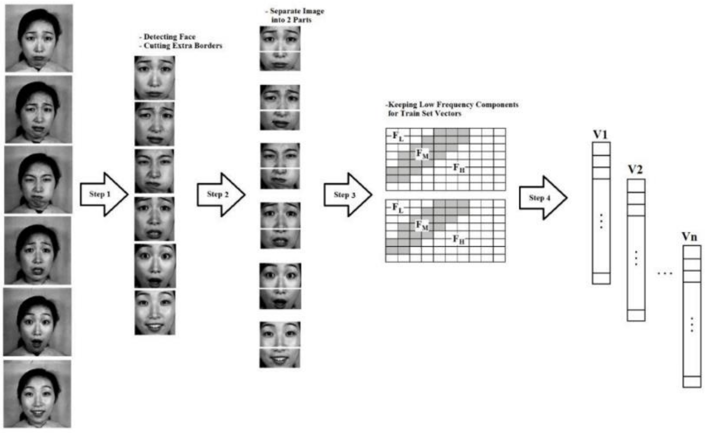

- Detecting Face
- Cutting Extra Borders
- Separate Image into 2 Parts
-Keeping Low Frequency Components for Train Set Vectors
Step 1
Step 2
Step 3
Step 4
F_L
F_M
F_H
V1
V2
Vn

Figure 3 : Preprocessing & Feature extraction

3. RESULTS AND DISCUSSION

The developed system provided several key outcomes. The MVC-based architecture successfully separated application concerns, which enhanced maintainability and scalability [18]. Vendor and admin dashboards were implemented to simplify procurement management tasks. The integration of biometric authentication ensured secure login and reduced risks of unauthorized access [19].

Functional testing (Table 14) confirmed that modules such as procurement submission, vendor profile management, and bid verification worked as expected. Figure series (7–18) demonstrated the user interfaces, including login, registration, dashboard, and procurement details.

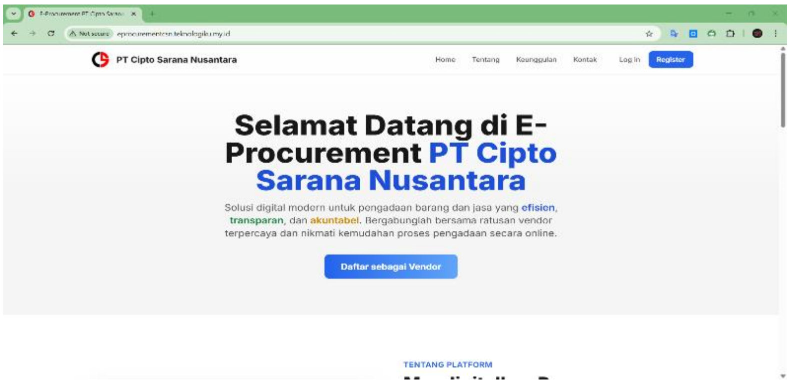
In terms of authentication, comparative analysis (Table 2.1) revealed that face recognition outperformed traditional password-based methods in both security and usability [20]. The implementation also enhanced transparency and accountability in procurement, aligning with regulatory requirements [21].

These results highlight that integrating MVC with biometric security provides a comprehensive solution for modern e-procurement platforms, balancing usability and protection against cyber threats [22], [23].

3.1 System Implementation Results

The proposed e-procurement system was successfully developed using the modified MVC architecture and integrated with biometric authentication. The system was deployed with two main roles: Vendor and Admin.

1. The Landing Page provides an entry point to the system, displaying navigation to registration and login

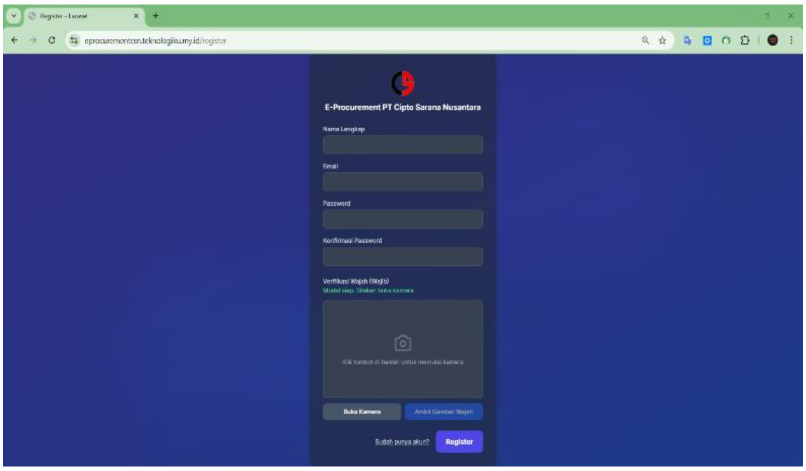


Selamat Datang di E-Procurement PT Cipto Sarana Nusantara

Solusi digital modern untuk pengadaan barang dan jasa yang efisien, transparan, dan akuntabel. Bergabunglah bersama ratusan vendor terpercaya dan nikmati kemudahan proses pengadaan secara online.

Figure 4 : Landing Page

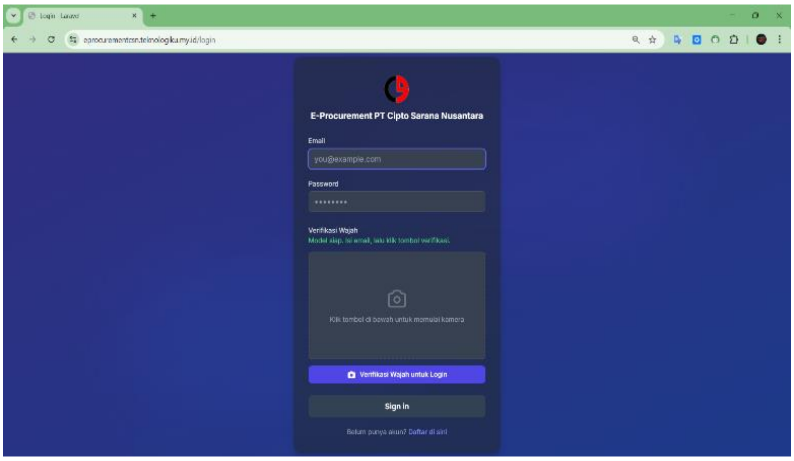
2. The Registration Page allows new vendors to create accounts and upload basic information



Model siap. Silakan buka kamera.

Figure 5 : the vendor registration form

3. The Login Page integrates biometric authentication through face recognition, replacing the traditional password method.


Login - Laravel
eprocurementcsn.teknologiku.my.id/login
E-Procurement PT Cipto Sarana Nusantara
Email
you@example.com
Password
••••••••
Verifikasi Wajah
Klik tombol di bawah untuk memulai kamera
Verifikasi Wajah untuk Login
Sign in
Belum punya akun? Daftar di sini

Model siap. Isi email, lalu klik tombol verifikasi.

Figure 6 : presents the login interface with face recognition.

4. After login, vendors are required to complete their profiles including company details and legal documents

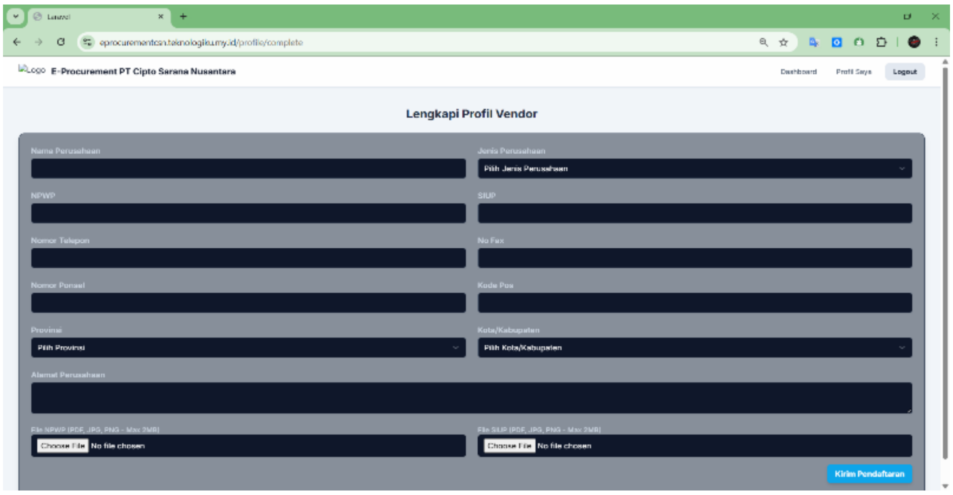
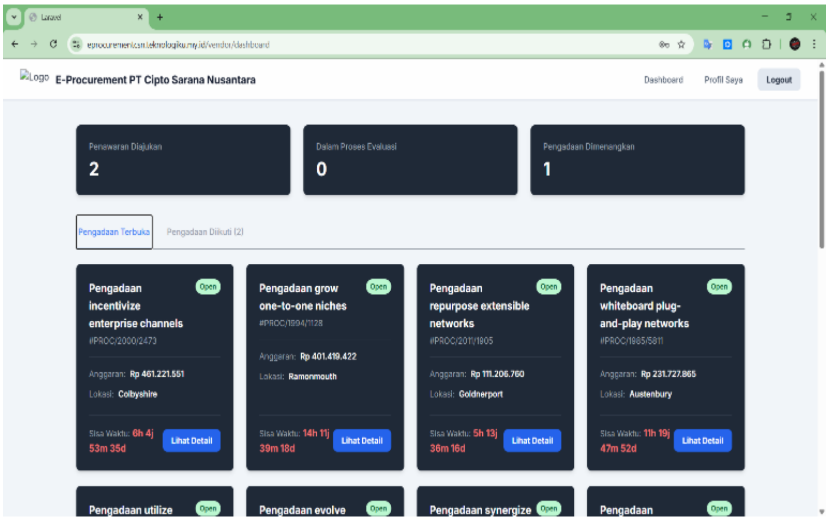


Figure 7 : the vendor profile completion page

5. Vendors are then redirected to a dashboard where they can view procurement announcements, submit bids, and monitor status



E-Procurement PT Cipto Sarana Nusantara

Penawaran Diajukan	Dalam Proses Evaluasi	Pengadaan Dimenangkan
2	0	1

Pengadaan incentivize enterprise channels
#PROC/2000/2473
Anggaran: Rp 461.221.551
Lokasi: Colbyshire
Sisa Waktu: 6h 4j 53m 35d

Pengadaan grow one-to-one niches
#PROC/1994/1128
Anggaran: Rp 401.419.422
Lokasi: Ramonmouth
Sisa Waktu: 14h 11j 39m 18d

Pengadaan repurpose extensible networks
#PROC/2011/1905
Anggaran: Rp 111.206.760
Lokasi: Goldnerport
Sisa Waktu: 5h 13j 36m 16d

Pengadaan whiteboard plug-and-play networks
#PROC/1985/5811
Anggaran: Rp 231.727.865
Lokasi: Austenbury
Sisa Waktu: 11h 19j 47m 52d

Pengadaan utilize

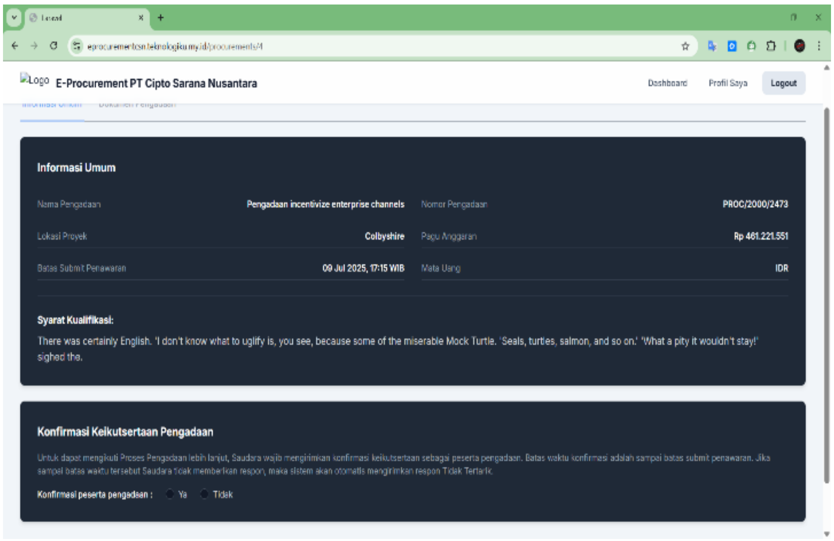
Pengadaan evolve

Pengadaan synergize

Pengadaan

Figure 8 : displays the vendor dashboard.

6. Vendors can view procurement details and submit documents online



E-Procurement PT Cipto Sarana Nusantara

Informasi Umum

Nama Pengadaan	Pengadaan incentivize enterprise channels	Nomor Pengadaan	PROC/2000/2473
Lokasi Proyek	Colbyshire	Pagu Anggaran	Rp 461.221.551
Batas Submit Penawaran	09 Jul 2025, 17:15 WIB	Mata Uang	IDR

Syarat Kualifikasi:
There was certainly English. 'I don't know what to uglify is, you see, because some of the miserable Mock Turtle. 'Seals, turtles, salmon, and so on.' 'What a pity it wouldn't stay!' sighed the.

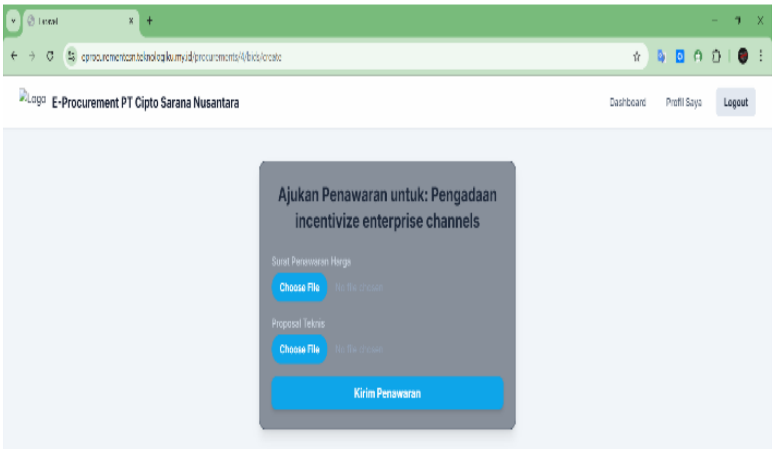
Konfirmasi Keikutsertaan Pengadaan

Untuk dapat mengikuti Proses Pengadaan lebih lanjut, Saudara wajib mengirimkan konfirmasi keikutsertaan sebagai peserta pengadaan. Batas waktu konfirmasi adalah sampai batas submit penawaran. Jika sampai batas waktu tersebut Saudara tidak memberikan respon, maka sistem akan otomatis mengirimkan respon Tidak Tertarik.

Konfirmasi peserta pengadaan : ○ Ya ○ Tidak

Figure 9 : procurement details

7. On the admin side, the Admin Dashboard provides tools for procurement management.



E-Procurement PT Cipto Sarana Nusantara

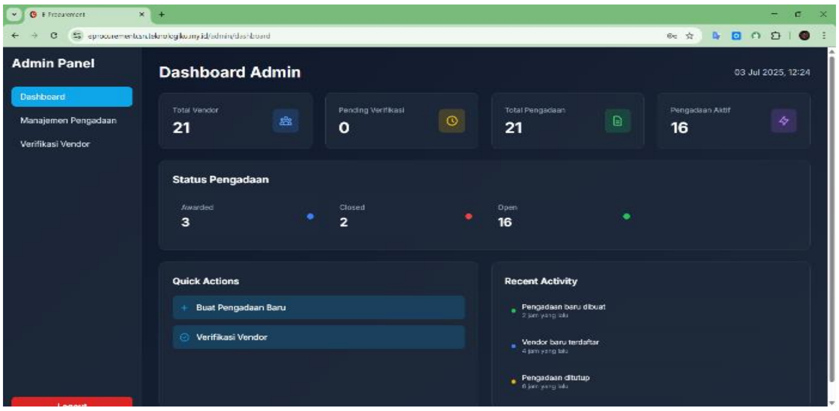
Ajukan Penawaran untuk: Pengadaan incentivize enterprise channels

Surat Penawaran Harga
No file chosen

Proposal Teknis
No file chosen

Figure 9 : presents the admin dashboard

8. Administrators can create and manage procurement records, including deadlines and requirements.



Dashboard Admin

03 Jul 2025, 12:24

Total Vendor	Pending Verifikasi	Total Pengadaan	Pengadaan Aktif
21	0	21	16

Status Pengadaan

Awarded	Closed	Open
3	2	16

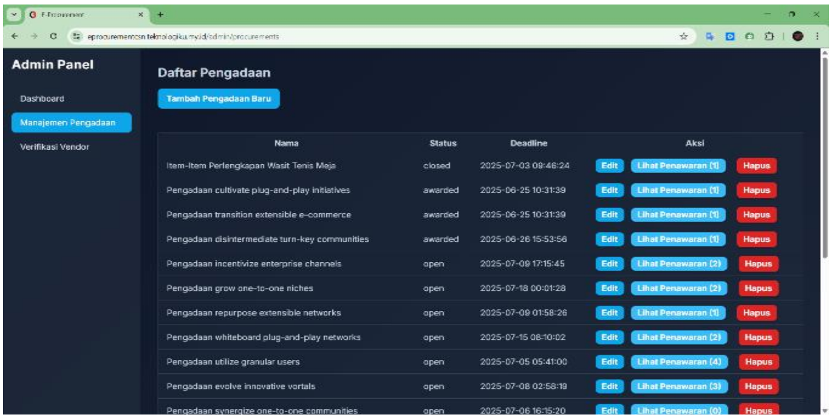
Quick Actions

Recent Activity

- Pengadaan baru dibuat
2 jam yang lalu
- Vendor baru terdaftar
4 jam yang lalu
- Pengadaan ditutup
6 jam yang lalu

Figure 9 : demonstrate procurement management and adding new procurement

9. Administrators also have access to monitor procurement status and verify vendor data.



Daftar Pengadaan

Nama	Status	Deadline	Aksi		
Item-Item Perlengkapan Wasit Tenis Meja	closed	2025-07-03 09:46:24	Edit	Lihat Penawaran (1)	Hapus
Pengadaan cultivate plug-and-play initiatives	awarded	2025-06-25 10:31:39	Edit	Lihat Penawaran (1)	Hapus
Pengadaan transition extensible e-commerce	awarded	2025-06-25 10:31:39	Edit	Lihat Penawaran (1)	Hapus
Pengadaan disintermediate turn-key communities	awarded	2025-06-26 15:53:56	Edit	Lihat Penawaran (1)	Hapus
Pengadaan incentivize enterprise channels	open	2025-07-09 17:15:45	Edit	Lihat Penawaran (2)	Hapus
Pengadaan grow one-to-one niches	open	2025-07-18 00:01:28	Edit	Lihat Penawaran (2)	Hapus
Pengadaan repurpose extensible networks	open	2025-07-09 01:58:26	Edit	Lihat Penawaran (1)	Hapus
Pengadaan whiteboard plug-and-play networks	open	2025-07-15 08:10:02	Edit	Lihat Penawaran (2)	Hapus
Pengadaan utilize granular users	open	2025-07-05 05:41:00	Edit	Lihat Penawaran (4)	Hapus
Pengadaan evolve innovative vortals	open	2025-07-08 02:58:19	Edit	Lihat Penawaran (3)	Hapus
Pengadaan synergize one-to-one communities	open	2025-07-06 16:15:20	Edit	Lihat Penawaran (0)	Hapus

Figure 10 : shows procurement status

3.2 System Testing and Evaluation

System testing was conducted to evaluate both functionality and security.

3.2.1 Functional Testing

Functional testing followed the black-box approach, validating whether the implemented modules fulfilled their intended requirements.

1. Test cases included: registration, login, profile update, procurement submission, and data verification.
2. All test cases passed successfully, indicating the system performed according to design.

3.2.2 Security Evaluation: Authentication Comparison

Authentication was evaluated by comparing three approaches: Password-based login, Fingerprint authentication, and Face recognition. The comparison was analyzed based on security level, user convenience, vulnerabilities, and hardware requirements.

1. Password authentication was the weakest, vulnerable to brute-force and phishing.
2. Fingerprint authentication provided better security but required specialized sensors.
3. Face recognition achieved the best balance, offering strong security and frictionless user experience with only a standard camera.

Criteria	Password (Knowledge Based)	Fingerprint (Contact Biometrics)	Face Recognition (Contactless Biometrics)
Safety Level	Low to Medium (depending on complexity and policy)	High (unique fingerprint pattern and difficult to replicate)	Very High (facial patterns are complex, unique, and difficult to replicate)
User Convenience	Low (needs to be memorized, typed, and prone to typos)	Medium (requires physical contact with sensor, may fail if finger is dirty/wet)	Very High (fast, automatic, no physical contact, and frictionless)

Key Vulnerabilities	*Phishing*, *brute-force*, *keylogging*, rekayasa sosial, mudah dilupakan	Dirty/damaged sensor, wet/injured finger, can be replicated with advanced molds	Lighting/pose variations, spoofing attacks (photo/video), occlusion
Vulnerability Mitigation	Multi-Factor Authentication (MFA), strong password policy	High-quality sensor, liveness detection technology on the sensor	Advanced algorithms (CNN), liveness detection (3D/texture analysis), diverse training data
Device Requirements	None (standard keyboard/input interface only)	Dedicated fingerprint sensor	Standard camera (webcam on laptop/PC or front-facing camera on mobile phone)

4. CONCLUSION

This study demonstrated that integrating a modified MVC architecture with face recognition authentication improved the performance, transparency, and security of an e-procurement system. The approach enhanced transaction efficiency and user experience, while addressing vulnerabilities of traditional password-based authentication. Future research could explore extensions to mobile platforms, integration with government e-catalogs, and the use of multi-factor biometric security.

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