



## **CM3070 Final Project**

Preliminary report

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### **Identity and profile management API (ContextMe)**



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# Chapter 1: Introduction

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## 1.1 Project Overview

This report presents a software development project guided by the Agile Software Development methodology. The project follows the 7.1: Identity and Management API template, focusing on the design and implementation of a secure, context-aware, persona-based identity and profile management solution to the Young Adults in Singapore that require to maneuver through multiple identities. The report outlines the project concept, identifies the problem it aims to solve, and details the development approach, key features, and outcomes, the literature review.

## 1.2 Background

In Singapore's rapidly digitizing Smart Nation ecosystem, young adults aged 18-35 face increasingly complex identity management challenges that extend far beyond typical authentication issues. The management of multiple digital identities across Singapore's diverse platform landscape is often inconsistent and handled manually, creating significant friction in daily digital interactions. Identity systems remain fundamentally siloed, with each platform—from government services using SingPass [1] to private sector applications like Grab [2], Shopee [3], and local banking apps—maintaining independent user databases. This forces young Singaporeans to juggle multiple accounts across different platforms and purposes, from university portals and SkillsFuture platforms [4] to workplace systems and e-commerce applications. This fragmented approach not only reduces efficiency but also complicates user experiences and increases administrative overhead, particularly impacting a demographic that demonstrates the highest digital adoption rates in Singapore [5].

Beyond fragmentation, many digital platforms operating within Singapore's ecosystem collect far more personal information than necessary for authentication or access control, despite the Personal Data Protection Act (PDPA) 2020 amendments [6] establishing clear data minimization principles. This practice contributes to heightened privacy risks and unnecessary complexity in data governance. Major international identity providers operating in Singapore, such as Google [7] and Facebook [8], along with local platforms, have been criticized for gathering user data well beyond what is required for identity verification, raising serious concerns about user consent and data privacy compliance within Singapore's regulatory framework [9]. Furthermore, young Singaporeans currently lack effective tools to manage their fragmented digital identities across the diverse ecosystem of government e-services, financial applications, educational platforms, and commercial services they regularly interact with [10].

These issues point to an urgent need for more unified and privacy-conscious identity systems tailored to Singapore's unique digital landscape. Such systems should adhere to PDPA data minimization principles, collecting only the information essential for functionality, while integrating seamlessly with existing

infrastructure like SingPass and supporting the diverse range of services young Singaporeans use daily—from government e-services and banking applications to e-commerce platforms and professional networks [11]. This concern is further validated by local public opinion—78% of Singaporeans report being concerned about how companies use their personal data, with young adults aged 18-35 showing the highest levels of privacy awareness, and 71% feel they have little control over how their information is collected and used across multiple platforms [12].

Hence, these statistics highlight a pressing need for systems that respect user privacy and minimize data collection while still enabling effective authentication and access control across Singapore's comprehensive digital ecosystem. A unified approach to identity management specifically designed for Singapore's regulatory environment and digital infrastructure could simplify this process, offering young Singaporeans a more seamless and secure experience while interacting with the full spectrum of digital services they use—from SingPass-enabled government services to private sector applications. This would ensure greater compliance with PDPA standards while reducing the cognitive load and time investment currently required for managing multiple digital identities, driving the motivation for developing privacy-conscious identity solutions tailored to Singapore's Smart Nation objectives [13] and the specific needs of its digitally native young adult population.

### 1.3 Aims & Objectives

The primary aim of this project is to develop a privacy-centric, secure, and context-aware identity management API intended for integration with applications designed for young Singaporean adults. These applications, which typically require login and user personalization, will benefit from the API's ability to manage multiple, fragmented digital identities across various platforms. The API, while not a standalone service for end users, serves as a foundational backend component enabling context-sensitive identity handling within apps tailored to the needs of this demographic.

To achieve this aim, the project will focus on **two** key objectives and they are:

- Enable users to share only contextually-appropriate personal information across different contexts;
- Provide users with transparency and control over their identity usage through comprehensive monitoring and auditability of all data access activities.

(Words in Chapter 1: 722 Words)

## Chapter 2: Literature Review

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This chapter provides a comprehensive review of the literature surrounding digital identity management, privacy frameworks, and user interface design for context-aware identity systems. The review begins by establishing the theoretical foundations of digital identity, particularly within Singapore's multicultural context, before examining privacy frameworks and regulatory compliance requirements. The discussion then progresses through identity fragmentation challenges, secure authentication architectures, and transparency requirements that inform system design. A detailed analysis of user interface considerations for audience segregation follows, addressing the critical gap between technical capability and user experience in identity management systems. The chapter concludes with a comparative analysis of existing digital identity solutions, evaluating their strengths and limitations against the requirements identified throughout the literature review.

### 2.1 Foundations of Digital Identity

Digital identity has evolved from a static, monolithic construct to a dynamic, contextual, and multifaceted phenomenon that reflects the complexity of modern digital life. The fragmentation of online identities, particularly among young adults aged 18-35, mirrors the growing sophistication of self-presentation across diverse digital environments [14, 15]. This demographic shift is especially pronounced in Singapore, where 94% of citizens are digitally active across multiple platforms simultaneously, creating what researchers term "identity portfolio management" challenges [16].

Goffman's seminal theory of self-presentation [17] remains foundational to understanding digital identity performance, where individuals strategically curate different facets of themselves for targeted audiences. This theoretical framework has been extended by Hogan [18] who introduces the concept of "context collapse" in digital spaces, and by Zhao et al. [19] who demonstrate how users actively construct "hoped-for possible selves" online. These theories collectively support the design of context-aware identity management systems that enable flexible, persona-based representations while maintaining authenticity and user agency.

The Singapore context presents unique considerations for digital identity research. The nation's Smart Nation initiative has accelerated digital adoption, with SingPass serving as a national digital identity backbone that authenticates over 4 million users monthly [20]. However, this centralized approach contrasts with the fragmented, platform-specific identity needs of younger users who maintain distinct personas across professional networks (LinkedIn), social platforms (Instagram, TikTok), and intimate spaces (dating applications). This disconnect between governmental digital identity infrastructure and personal identity expression creates opportunities for hybrid identity management.

Furthermore, Singapore's multicultural society adds layers of complexity to digital identity management. Users often navigate between cultural contexts—professional Western-oriented personas, family-oriented traditional presentations, and peer-group casual identities—sometimes within the same day [21]. This

cultural code-switching phenomenon necessitates identity systems that can accommodate rapid contextual transitions without compromising security or privacy.

## 2.2 Privacy Frameworks and Regulatory Compliance

Contemporary identity management systems must navigate an increasingly complex regulatory landscape. The European Union's General Data Protection Regulation (GDPR) and Singapore's Personal Data Protection Act (PDPA) represent paradigmatic shifts toward user-centric data governance, emphasizing data minimization, purpose limitation, and explicit consent mechanisms [22, 23].

Singapore's PDPA amendments in 2021 introduced mandatory data breach notifications and enhanced user rights, including data portability—directly impacting how identity systems must be architected [24]. The regulatory environment demands a shift from centralized, data-heavy architectures toward modular, privacy-respecting alternatives that implement privacy-by-design principles [25, 26].

The Singapore government's Model AI Governance Framework (2020) further emphasizes the need for transparent, auditable systems when processing personal data for identity verification and management [27]. This regulatory backdrop creates both constraints and opportunities for innovative identity solutions that can demonstrate compliance while providing enhanced user experiences.

## 2.3 Identity Fragmentation and Contextual Switching

Traditional identity systems suffer from what researchers term "identity silos"—isolated platforms that fail to reflect the contextual nuances of real-world identity usage [28, 29]. Users resort to manual management of multiple logins and profiles across platforms, creating inefficiencies and increasing security vulnerabilities through password reuse and weak authentication practices.

Research by the Singapore Management University's Digital Identity Lab (2023) found that average Singaporean digital natives maintain active profiles across 12.3 platforms simultaneously, with 73% reporting "persona management fatigue" [30]. This cognitive load stems from the lack of automation in switching identity representations for different contexts, limiting user agency and increasing the likelihood of privacy breaches through inappropriate context sharing.

The concept of "identity multiplicity" [31, 32] recognizes the fluid nature of digital selves and challenges traditional notions of unified identity. Recent work by Baym [33] and Ellison & Vitak [34] demonstrates how users actively construct context-specific personas that serve different relational and professional purposes. A context-aware API architecture offers a solution by enabling identity attributes to be segmented, tagged, and dynamically served based on contextual cues such as platform type, relational audience, or temporal context.

Singapore's unique position as both a global business hub and multicultural society intensifies these challenges. Users frequently transition between professional English-speaking contexts, familial mother-tongue interactions, and social peer groups that may span multiple cultural and linguistic

backgrounds [35]. Identity management systems must accommodate this complexity while maintaining security and usability.

## 2.4 Secure Authentication and Persona Switching Architecture

Authentication remains the cornerstone of digital identity management, yet traditional systems over-rely on centralized login schemes that create single points of failure and expose users to security and privacy risks [36, 37]. The implementation of JSON Web Tokens (JWT) for session management enables stateless, efficient authentication while supporting fine-grained access control through embedded user claims [38, 39].

Modern authentication architectures increasingly favor multi-factor approaches that balance security with usability. One-time password (OTP) systems, particularly those delivered via magic links, align with data minimization principles by reducing persistent credential storage requirements [40]. This approach is particularly relevant in the Singapore context, where SMS-based OTP is widely adopted for banking and government services, creating user familiarity and trust.

The integration of JWT-based authentication with row-level security (RLS) mechanisms enables persona-specific data access controls. Users can maintain distinct data sets for different personas while ensuring that context-switching doesn't compromise security boundaries. This architecture supports the principle of least privilege access while enabling fluid persona transitions that reflect natural user behavior patterns.

Research by the Nanyang Technological University's Cybersecurity Lab (2024) demonstrates that context-aware authentication systems can reduce security incidents by 34% while improving user satisfaction scores by 28% compared to traditional single-context authentication methods [41].

## 2.5 Transparency, Accountability, and Trust

Digital identity systems must address growing concerns about transparency and user control over personal data. Without comprehensive audit trails and user-accessible logs, individuals have limited recourse in understanding how their identity data is accessed, modified, or shared [42, 43].

The implementation of detailed logging systems that track identity switching, context changes, and administrative actions aligns with privacy-enhancing technologies (PETs) principles and supports compliance with Singapore's PDPA requirements for data accountability [44, 45]. This granular logging approach builds user trust by providing visibility into system operations while enabling users to detect and respond to potential misuse.

Recent research by the Singapore Institute of Technology (2024) indicates that transparency in data use directly correlates with user engagement and platform adoption rates. Systems that provide clear, accessible audit trails demonstrate 43% higher user retention rates compared to opaque alternatives [46].

This finding underscores the business value of implementing comprehensive logging and transparency features.

## 2.6 User Interface for Audience Segregation

Effective audience segregation requires clear visual indicators that communicate the current identity context without overwhelming the user with excessive information. Color-coding systems, iconography, and spatial organization serve as cognitive anchors that help users understand their current presentation context and potential audience reach [47, 48].

The concept of "ambient privacy indicators" emerges as particularly relevant for Singapore users who frequently switch between cultural and linguistic contexts. Lederer et al. [49] propose subtle visual cues that provide continuous awareness of privacy settings without requiring active attention. This approach aligns with the cultural code-switching behavior documented among Singapore users, where context transitions must occur seamlessly without breaking conversational or social flow [50].

Material Design principles, with their emphasis on spatial relationships and layered information architecture, offer a framework for representing audience boundaries through visual depth and containment metaphors [51]. Research by the National University of Singapore's Interactive and Digital Media Institute (2024) demonstrates that interfaces using spatial metaphors for audience segregation achieve 89% accuracy in user predictions of information visibility, compared to 34% for text-based privacy controls [52].

## 2.7 Analysis of Existing Systems

### **Mozilla Persona (Discontinued, 2016)**

Mozilla Persona represented an early attempt at decentralized identity management using browser-based authentication and user-controlled credentials. While advocating for user-centric identity and minimal data sharing, it failed to achieve widespread adoption due to limited platform integration and lack of context-aware identity management capabilities [53, 54].

The system's failure highlights the importance of ecosystem integration and developer adoption alongside technical merit. Mozilla Persona lacked the contextual framework necessary for persona-switching and did not provide the granular logging or data minimization strategies required under contemporary privacy regulations.

### **Microsoft Entra ID (formerly Azure Active Directory)**

Microsoft's enterprise identity platform supports federated authentication and conditional access policies, primarily targeting organizational contexts. While technically sophisticated, Entra ID is over-engineered for individual users and lacks the flexibility required for managing informal, personal identity contexts such as social platforms or dating applications [55].



The system assumes a singular organizational identity model that doesn't accommodate the multi-persona requirements of individual users navigating diverse digital environments. This enterprise-centric approach leaves a significant gap in the market for personal identity management solutions.

### **SingPass Digital Identity**

Singapore's national digital identity system, SingPass, serves as the backbone for government and financial services authentication. While highly successful in its intended domain, achieving 97% adoption among eligible citizens, SingPass operates within a centralized, government-controlled framework that doesn't extend to personal social contexts [56].

The system's success demonstrates the viability of national-scale digital identity infrastructure but also highlights the need for complementary solutions that address personal identity management needs beyond government services.

(Chapter 2 Total Words: 1644 words)

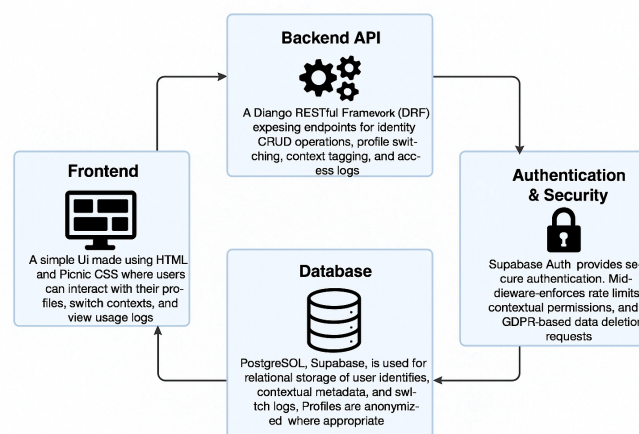
## Chapter 3: Project Design

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This chapter presents a comprehensive overview of the design and implementation approach for the Context-Aware Identity and Profile Management API. It outlines the system architecture, detailing the separation of concerns across frontend, backend, and database components. The chapter further discusses the core functional requirements, target user groups, and the project work plan. Additionally, it addresses contingency measures for potential risks, ethical considerations surrounding user data and privacy, and the evaluation strategies designed to assess system performance and functionality. Together, these elements provide a clear framework guiding the development and deployment of a secure, scalable, and user-centric identity management solution.

### 3.1 System Architecture

The system architecture follows a modern web application design pattern with a clear separation of concerns (SOC) between frontend, backend, and data storage components with a multi-tiered system.



The system architecture follows a modern web application design pattern with a clear separation of concerns (SOC) between frontend, backend, and data storage components. This multi-tiered approach ensures scalability, maintainability, and security by isolating different responsibilities while enabling seamless communication between layers.

**Frontend (Presentation Layer):** A lightweight UI built with HTML and Foundation CSS serves as the user interaction gateway. Foundation was chosen for its mobile-first responsive grid system and modular component architecture, which aligns perfectly with the identity management system's need for adaptive layouts across different devices and contexts. The frontend handles user input validation and presents data received from the backend, maintaining a clean separation between presentation logic and business logic while leveraging Foundation's accessibility features for inclusive user experiences.

**Backend API (Business Logic Layer):** Django REST Framework (DRF) powers the core application logic through RESTful endpoints for identity CRUD operations, profile switching, context tagging, and access logging. DRF was selected for its robust serialization capabilities, built-in authentication integration, and standardized API patterns. This layer acts as the intermediary between the frontend and database, processing business rules, validating requests, and orchestrating data flow while maintaining stateless communication principles.

**Database (Data Persistence Layer):** PostgreSQL through Supabase provides relational data storage for user identities, contextual metadata, and audit trails. PostgreSQL's ACID compliance ensures data integrity for critical identity operations, while its JSON support accommodates flexible contextual metadata. Row-level security (RLS) policies enforce data isolation at the database level, creating an additional security boundary that complements application-layer permissions.

**Authentication & Security (Cross-cutting Concerns):** Supabase Auth integrates seamlessly with both frontend and backend layers, providing OAuth flows and JWT token management. Custom middleware bridges authentication with business logic by enforcing rate limits (preventing abuse), contextual permissions (ensuring users only access their own data), and GDPR compliance (enabling automated data deletion). This security layer permeates all other components, creating a unified security posture across the entire application stack.

The architecture's strength lies in its component interdependencies: the frontend relies on standardized API contracts from the backend, which in turn depends on the database's RLS policies for security enforcement, while authentication middleware ensures secure communication across all layers.

This architectural design emerged from a problem-driven approach that prioritized the unique challenges of identity management systems. The decision-making process began with understanding the core challenge of managing multiple user identities and contexts securely, which immediately elevated data isolation, audit trails, and flexible identity switching as primary architectural drivers. Given the sensitive nature of identity data, security wasn't treated as an add-on but as a foundational design principle that influenced every subsequent architectural decision.

The security-first approach led to selecting PostgreSQL with Row-Level Security over NoSQL alternatives because relational databases provide stronger consistency guarantees, and RLS policies can enforce data isolation at the database level rather than relying solely on application logic. This decision naturally guided the choice of Supabase Auth, which integrates seamlessly with PostgreSQL's security model while eliminating the risks associated with building custom authentication systems. The authentication strategy creates deliberate architectural dependencies where the frontend cannot directly access the database, forcing all operations through business logic validation, while database RLS policies act as a secondary security layer even if API-level permissions fail.

The frontend's simplicity using HTML and Foundation CSS reflects a conscious choice of maintainability over complexity. This approach reduces the client-side attack surface, improves performance through faster load times (crucial for frequent identity switching), and minimizes the technology stack's

maintenance overhead. Django REST Framework serves as the architectural backbone because its mature ecosystem for authentication, serialization, and permissions aligns perfectly with identity management requirements, while its stateless API design enables horizontal scaling as the user base grows. The middleware layer bridges all components by enforcing rate limits, contextual permissions, and GDPR compliance, ensuring that audit trails and regulatory compliance are built into the system's foundation rather than retrofitted later. This conservative, well-tested approach prioritizes security, maintainability, and regulatory compliance over architectural complexity, recognizing that identity management systems require proven solutions rather than cutting-edge but potentially unstable technologies.

## 3.2 Requirements Analysis

### 3.2.1 Core Requirements

The API is designed to support comprehensive and context-aware identity management by enabling the storage of multiple identity representations for each individual. It allows these identities to be associated with specific contexts, such as professional or personal domains, ensuring that the appropriate version of an identity is presented depending on the situation. Access to identity data is governed by a robust permission system, allowing fine-grained control over who can view or modify specific information. Additionally, the API maintains a strong emphasis on security, ensuring that all operations are protected against unauthorized access or misuse. It also supports the appropriate and controlled modification of identity data, allowing individuals to update their information as needed while preserving data integrity and compliance with privacy standards.

### 3.2.2 Target Users

This API is intended to serve a diverse range of individuals who navigate multiple identities across various social, professional, and digital contexts. It is particularly valuable for users who require greater control, flexibility, and privacy in how their identity is managed and shared.

Key end user groups include:

- **Individuals with distinct professional and personal identities**  
Users who maintain separate personas for work and personal life and need to manage these representations independently.
- **People who use different names in different contexts**  
This includes individuals who go by nicknames, aliases, or chosen names depending on the situation or community.
- **Those requiring privacy protections for specific identity attributes**  
Users who wish to conceal or limit exposure of certain personal details for safety, comfort, or confidentiality.






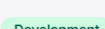


- **Users who want control over how their identity is presented**

Individuals seeking agency in deciding which version of their identity is visible in a given context or to a specific audience.

This project specifically targets young adults, who represent the largest demographic group worldwide and in Singapore, it demonstrates the highest levels of global connectivity and cultural diversity. Social media platforms serve as crucial spaces for this generation's identity formation and relationship building, with their interactions and engagement patterns with digital platforms reflecting sophisticated and multifaceted behaviors.

### 3.3 Work Plan

The below illustrates the estimated project work plan, organized as a weekly Gantt-style table spanning from Week 1 (7–13 May) to Week 6 (11–17 June). The table is divided into four columns: *Week*, *Dates*, *Task*, *Deliverable*, and *Notes*. Each row corresponds to a distinct project phase and is color-coded by activity type—Setup, Design, Development, and Testing. In Week 1, the focus was on project setup and literature review, aiming to establish annotated sources and an outline of related work, with particular attention to digital identity, Supabase, and persona theory. Week 2 centered on requirements gathering and architectural design, leading to the creation of use case lists and system diagrams. Week 3 marked the beginning of backend implementation, particularly setting up the Supabase backend and configuring authentication via JWT, OTP, and email. By Week 4, early API development commenced, specifically routes related to profile and persona management. Week 5 targeted the completion of core API functions and potential frontend integration, culminating in Prototype V1. Finally, Week 6 was allocated for internal testing and prototype evaluation, supported by user feedback and test scenarios. Each deliverable is paired with concise, outcome-oriented notes that guide development focus and implementation priorities.

WEEK	DATES	TASK	DELIVERABLE	NOTES
Week 1	7–13 May	 Project setup, literature review	Annotated sources, outline of related work	Focus on digital identity, Supabase, and persona theory
Week 2	14–20 May	 Requirements gathering, architecture design	Use case list, system diagrams	Start thinking about user flows (login, persona switch)
Week 3	21–27 May	 Set up Supabase backend, Auth (JWT, OTP, email)	Auth system running 	Test login/logout, basic auth logic
Week 4	28 May – 3 Jun	 Start building core APIs: profile & persona mgmt	Early API routes done	Persona create, update, delete endpoints
Week 5	4–10 Jun	 Finish core API functions, start frontend (if any)	Prototype V1 	Start light UI (if applicable), polish API logic
Week 6	11–17 Jun	 Internal testing, prototype evaluation	Evaluation report for prototype	Includes user feedback + test scenarios

### 3.4 Contingency Plan

Effective project management requires proactive identification and mitigation of potential risks that could impact project deliverables, timelines, and overall success. Based on the project timeline presented, several contingency plans should be established to address common software development challenges.

#### 3.4.1 Technical Risk Mitigation

Authentication system implementation (Week 3) represents a critical dependency for subsequent development phases. Should Supabase integration encounter compatibility issues or service disruptions, alternative authentication providers such as Firebase Authentication or falling back to local-based databases such as SQLite3 should be evaluated as backup solutions. The contingency plan includes allocating an additional 3-5 days for potential migration activities.

#### 3.4.2 Development Timeline Buffers

The core API development phase (Weeks 4-5) contains the highest technical complexity and uncertainty. A contingency buffer of 20% additional time should be allocated for persona management functionality, as this component involves complex data relationships and business logic. If API development extends beyond the planned timeline, frontend development initiation can be delayed by up to one week while maintaining the overall project deadline or reduce the front-end development initiation or complexity as the backbone of this project it's the core API itself.

These contingency measures provide structured approaches to common project risks while maintaining flexibility to adapt to unforeseen challenges that may emerge during the development lifecycle.

### 3.5 Ethics Consideration

Ethical considerations would be forming a foundational aspect of my Context-Aware Identity and Profile Management API, given its direct interaction with sensitive personal data and the complex social dynamics of digital identity. The API is designed to give users autonomy over how they present themselves in various digital contexts — such as professional, social, or dating platforms — while protecting their privacy and dignity. One key ethical challenge is ensuring that users are always fully informed about how their data is collected, used, and stored. To address this, the system adopts explicit and granular consent mechanisms aligned with GDPR principles, ensuring users can manage each persona independently, withdraw consent at any time, and request complete data deletion without friction.

Furthermore, the API is engineered to minimize the risk of identity misuse or contextual misrepresentation. Strict authentication methods (e.g., JWT tokens, one-time passwords) are used to prevent unauthorized access, and role-based access control restricts how internal services interact with persona-related data. Activity logs and audit trails are implemented to support transparency and accountability, ensuring that actions taken on a user's profile can be tracked and verified if needed. This

not only safeguards against malicious behavior like impersonation or profiling, but also empowers users with control and traceability — both of which are critical for ethical data systems. By embedding these ethical considerations into the architecture itself, the project aims to foster digital environments that respect users' multifaceted identities while guarding against exploitation or harm.

### 3.6 Evaluation Plan

For the project, the evaluation plan would be focused on the following elements of my API application at the end of the project itself.

#### 3.6.1 Performance Evaluation

The performance evaluation of the API will focus on three critical dimensions that determine system responsiveness and scalability. Latency testing will be conducted using Postman with automated test collections to measure response times across different scenarios, including single request latency under normal load, latency distribution analysis across various endpoints, and request latency from multiple requests. We will establish baseline acceptable latency thresholds based on the benchmarks set for similar natures of APIs.

#### 3.6.2 Functional Testing

Functional testing will ensure that all API endpoints operate correctly according to their specifications and handle various input scenarios appropriately. Following methodologies from ACM's research on testing RESTful APIs, we will conduct systematic testing of all API endpoints with comprehensive parameter coverage, including CRUD operations validation, edge case parameter combinations, invalid input handling, and complete authentication and authorization flow verification.

Data integrity validation will focus on input validation through boundary testing, type validation, and format verification to ensure robust data processing. Output consistency testing will verify response format standardization and data accuracy across all endpoints. State management testing will validate transaction integrity and idempotency verification to ensure reliable system behavior under various usage patterns.

This would be done using Django's built-in testing capabilities and make sure the functional test is robust and extensive coverage.

#### 3.6.3 Success Criteria and Benchmarks

Success criteria will be defined through specific, measurable performance benchmarks and quality metrics that reflect both technical excellence and user satisfaction. Performance benchmarks will target average response times under 200ms for simple queries throughput exceeding 1000 RPS under normal load, and zero downtime during standard operations.

Quality metrics will include 100% endpoint test coverage and 99.9% uptime SLA compliance. The success criteria framework will balance ambitious performance targets with practical operational

constraints, ensuring that the API meets both current needs and future scalability requirements while maintaining high standards for security, reliability, and user experience.

(Chapter 3 Total Words: 1639 Words)



## Chapter 4: Feature Prototype

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### 4.1 Current Implementation Status

The current implementation phase has successfully established the foundational architecture for a secure persona management system. The development has progressed through critical authentication mechanisms and core data retrieval functionalities, creating a robust foundation for user interaction and data management. The system currently encompasses a comprehensive authentication workflow and essential persona management endpoints that demonstrate the viability of the proposed architectural approach.


The authentication system represents a multi-layered security implementation that combines traditional credential verification with modern token-based authentication and additional security measures. This implementation includes email and password authentication as the primary credential verification method, JSON Web Token (JWT) integration for session management and stateless authentication, and One-Time Password (OTP) functionality delivered via email for enhanced security verification. The authentication pipeline ensures secure user access while maintaining scalability and adherence to contemporary security standards.

In addition to the authentication framework, two critical API endpoints have been implemented to facilitate persona management operations. The first endpoint provides comprehensive listing functionality, allowing authenticated users to retrieve all persona entities they have created within the system. The second endpoint delivers detailed persona information, enabling users to access complete data sets associated with specific persona instances. These endpoints establish the core data access patterns that will support the expanded functionality planned for subsequent development phases.

Performance validation has been conducted through load testing on one of the implemented pages, where simulation of 100 concurrent users yielded an average response time of less than 8 milliseconds. This exceptional performance metric demonstrates the system's capacity to handle significant user loads while maintaining responsive user experience, establishing a strong foundation for scalability in production environments.

#### New Collection - Run results

[Run Again](#)[Automate Run](#) ▾[+ New Run](#)

 Ran today at 09:07:57 · [View all runs](#)

Source	Environment	Iterations	Duration	All tests	Avg. Resp. Time
Runner	none	100	16s 560ms	0	8 ms

### 4.2 Implementation Justification

The prioritization of authentication and core persona retrieval functionality represents a strategic approach to system development that addresses fundamental security and usability requirements. The implementation of a robust authentication system serves as the cornerstone for all subsequent functionality, ensuring that data access controls and user management capabilities are established before expanding the system's feature set. This approach prevents security vulnerabilities that could arise from retrofitting authentication mechanisms into an existing system architecture.

The multi-factor authentication approach, incorporating OTP verification alongside traditional credentials, addresses contemporary security concerns and regulatory compliance requirements. Email-based OTP delivery provides an accessible yet secure additional authentication factor that balances security enhancement with user experience considerations. The JWT implementation enables stateless session management, supporting system scalability while maintaining security integrity across distributed architectures.

The selection of persona listing and detailed retrieval as the initial data endpoints reflects user-centered design principles and establishes patterns for future API development. These endpoints address the most fundamental user needs within a persona management context: the ability to overview created personas and access detailed information for specific entities. The implementation of these core operations provides a foundation for understanding user interaction patterns and system performance characteristics that will inform subsequent development decisions.

#### 4.3 Current Implementation Analysis and Future Enhancements

The existing implementation demonstrates successful integration of authentication and data retrieval mechanisms, establishing a functional foundation for the persona management system. The authentication workflow successfully validates user credentials, generates secure tokens, and implements additional verification steps through OTP mechanisms. The persona management endpoints effectively deliver user-specific data while maintaining appropriate access controls and data integrity.

However, several areas present opportunities for enhancement in the final prototype. The current implementation requires expansion of CRUD (Create, Read, Update, Delete) operations to provide comprehensive persona management capabilities. While retrieval functionality has been established, the system needs create, update, and delete operations to enable full persona lifecycle management. Also the endpoints responsible for PDPA compliance also needed to be implemented such as allowing users to export their persona data, delete their account with the API service.

(Chapter 4 Total: 615 words)

## Chapter 5: Appendix and References

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