CHAPTER ONE: E-VISA APPLICATION SYSTEM

1.1 Introduction

The E-Visa Application System is a digital solution designed to streamline the visa application process for both applicants and government immigration authorities. Traditionally, visa applications have involved manual paperwork, in-person visits to embassies or consulates, long queues, and prolonged waiting times for approvals or rejections. This process is often inefficient, error-prone, and stressful for applicants, while simultaneously burdening administrative staff with extensive document handling, verification, and data storage tasks.

With the global shift towards digital governance and e-services, countries worldwide are adopting electronic visa (E-Visa) systems. Such systems enable applicants to submit applications online, upload supporting documents, pay application fees electronically, and track the progress of their applications in real-time. The E-Visa System also improves transparency, enhances security through digital verification, and reduces the risk of document fraud or misplacement.

This chapter provides a comprehensive overview of the proposed E-Visa Application System, including its background, objectives, research questions, justification, risk assessment, system requirements, budget, and a project timeline presented as a Gantt chart.

1.2 Background of the Study

Visa processing is a critical function of immigration and border management in any country. Traditionally, visa applications have relied heavily on manual processes, where applicants fill out paper forms, attach physical documents, and submit them in person at consulates or immigration offices. These conventional methods are often associated with significant challenges. The procedures are time-consuming, as each application requires verification of documents, approval from multiple departments, and physical handling of paper files. Consequently, applicants may wait several weeks or even months to receive a response.

Manual visa application processes are also prone to errors. Missing signatures, incorrect information, or lost documents can result in delays or outright rejection of applications. Accessibility is another major concern. Applicants living in remote areas often face difficulties accessing consular offices or submitting applications within limited working hours, creating inequalities in service availability. Furthermore, security risks such as document forgery, tampering, and mismanagement are prevalent in manual systems. Tracking applications and preventing duplicate submissions is challenging, which may compromise both efficiency and trust.

Administrative burdens for immigration authorities are substantial. Managing large volumes of paperwork, maintaining secure storage, and manually tracking the status of applications consumes resources and increases operational costs. These challenges highlight the pressing need for modernization through digital solutions.

To address these issues, E-Visa systems have been introduced in many countries worldwide. These systems allow applicants to submit applications online, upload supporting documents, pay application fees electronically, and track application status in real time. E-Visa systems leverage database management, secure authentication, and automated workflows to improve efficiency, accuracy, and security.

In Kenya, the demand for an E-Visa Application System has grown due to increasing international travel, tourism expansion, and the need to modernize government services in line with digital transformation initiatives. An automated system can reduce human errors, provide real-time application tracking, ensure data security, and enhance the overall experience for applicants. It also enables the government to maintain a centralized database of applicants, facilitating faster verification, analysis, and reporting.

Implementing an E-Visa Application System aligns with global best practices in digital governance. It presents a sustainable solution for the evolving demands of international travel management, while providing a secure, transparent, and efficient platform that benefits both applicants and immigration authorities.

1.3 Objectives

1.3.1 Main Objective

The main objective of this study is to design and implement a secure, efficient, and user-friendly E-Visa Application System that automates the visa application process. The system aims to improve applicant convenience by enabling online submission, document upload, payment, and real-time application tracking. It also seeks to assist immigration authorities by reducing manual workload, minimizing errors, enhancing security, and providing reporting capabilities for better decision-making.

1.3.2 Specific Objectives

1. To develop an online platform for applicants to submit visa applications and upload supporting documents.
2. To implement a secure authentication system for both applicants and immigration officers.

3. To design a backend system for visa processing, including application tracking and status notifications.
4. To integrate online payments for visa fees.
5. To reduce the processing time and minimize errors in visa application handling.
6. To generate reports and maintain a centralized database of visa applications.
7. To provide user training and support for both applicants and immigration staff.

1.4 Research Questions

1. How can an online platform be developed for applicants to submit visa applications and upload supporting documents?
2. What security measures are required to ensure safe authentication for both applicants and immigration officers?
3. How can a backend system be designed to track and manage visa applications efficiently?
4. How can online payment be integrated securely into the E-Visa Application System?
5. What strategies can be used to reduce processing time and minimize errors in visa handling?
6. How can reports and a centralized database be generated and maintained for visa applications?
7. How can effective user training and support be provided for both applicants and staff?

1.5 Justification of the Study

The study is justified due to the increasing demand for digital government services, the need to reduce manual paperwork, and the growing volume of international travelers. Implementing an E-Visa Application System offers multiple benefits. It enhances efficiency by reducing the time taken for visa processing and approvals. It improves accessibility by providing online access for applicants regardless of location. Security is strengthened by minimizing risks of fraud and document tampering through digital verification. The system also reduces administrative workload and resource use, while promoting transparency by enabling applicants to track the status of their applications.

1.6 Risk and Mitigation

The development and implementation of the E-Visa Application System may encounter several risks.

- **Data breaches:** Sensitive applicant information could be compromised. Mitigation: strong encryption, secure login protocols, and regular security audits.

- **System downtime:** Service interruptions. Mitigation: reliable hosting, backup servers, disaster recovery plan.
- **User errors:** Incorrect data submission. Mitigation: user-friendly interface, clear instructions, online tutorials.
- **Payment fraud:** Online payments risk. Mitigation: secure and verified payment gateways.
- **Resistance to adoption:** From staff and applicants. Mitigation: awareness campaigns, training, continuous support.

1.7 System Requirements

1.7.1 Hardware Requirements

- Server with at least 8GB RAM and 500GB storage
- Client devices (PC, laptop, smartphone)
- Reliable internet connection

1.7.2 Software Requirements

- Operating System: Windows Server/Linux
- Database: MySQL/PostgreSQL
- Web Server: Apache/Nginx
- Programming Language: PHP/JavaScript/Python
- Frontend Framework: HTML5, CSS3, JavaScript
- Payment Gateway Integration API

1.8 Budget

Item	Quantity	Unit Cost (USD)	Total Cost (USD)
Server	1	1000	1000
Software Licenses	-	500	500

Development Tools	-	300	300
Internet & Hosting	12 months	50	600
Testing & Maintenance	-	400	400
Total	-	-	2800

1.9 Gantt Chart

Activity	Month 1	Month 2	Month 3	Month 4	Month 5
Requirement Analysis	[redacted]				
System Design	[redacted]				
Development	[redacted]	[redacted]	[redacted]	[redacted]	
Testing & Debugging	[redacted]	[redacted]			
Deployment	[redacted]	[redacted]			
User Training					

CHAPTER TWO: E-VISA APPLICATION SYSTEM

LITERATURE REVIEW

Introduction

The rapid evolution of digital transformation has significantly reshaped the provision of public services globally, with governments adopting e-governance solutions to improve the efficiency, transparency, accessibility, and accountability of service delivery. Among these advancements is the Electronic Visa (E-Visa) system, which enables visa applicants to submit applications online without the need for physical appointments at embassies or consular offices. Existing studies reveal that E-Visa platforms reduce administrative workloads, minimize document handling errors, and accelerate visa approval processes, thus enhancing tourism, trade, and international mobility (United Nations, 2022). However, despite these benefits, most current E-Visa systems lack intelligent assistance features that can guide users through complex application requirements. Applicants frequently encounter challenges such as selecting the correct visa type, understanding eligibility criteria, compiling required documents, and interpreting instructions in unfamiliar languages. This leads to high rejection rates, repeated applications, and poor user satisfaction. To address these limitations, recent research proposes integrating intelligent technologies—such as recommendation systems—into E-Visa platforms to improve user decision-making, personalization, and application success.

This literature review examines existing studies on recommendation systems, including collaborative filtering, hybrid methods, and their application in digital platforms—particularly in educational technology—to highlight their relevance in enhancing the E-Visa experience. It also critically analyzes issues such as data availability, algorithmic bias, ethical concerns, user acceptance, and system limitations to identify gaps that justify the proposed study.

Overview of Recommendation Systems

Recommendation systems are intelligent computational tools designed to suggest relevant actions, items, or decisions to users by analyzing patterns of behavior, preferences, and historical data. They are widely used in domains such as e-commerce, digital entertainment, healthcare, banking, and education to improve personalization and assist users in selecting relevant services. These systems apply machine learning techniques, user profiling, and predictive analytics to solve the problem of information overload by narrowing choices to items most likely to interest the user.

Recommendation systems function based on either explicit feedback—such as ratings, likes, reviews—or implicit data such as browsing history, interaction logs, and search patterns (Ricci, Rokach, & Shapira, 2015). In digital systems, recommendation engines operate in real-time, dynamically adjusting user behavior to refine suggestions. The core advantage of recommendation systems is their ability to increase user engagement, improve decision-making, and enhance service delivery efficiency.

In the context of E-Visa systems, recommendation technology can play a transformative role in guiding applicants by suggesting the most suitable visa category, identifying missing documents, recommending travel insurance providers, and offering application tips relevant to the applicant's nationality and travel purpose. By learning from previous applicants with similar profiles, a recommendation-enabled E-Visa platform would reduce confusion and application rejection rates. However, while recommendation systems are well studied in commercial applications, their application in digital government services remains limited, indicating a significant research opportunity.

Collaborative Filtering

Collaborative filtering is one of the most widely used recommendation techniques based on the principle that users who shared similar interests or behaviors in the past will likely have similar preferences in the future. Unlike rule-based recommendation methods, collaborative filtering does not rely on content analysis of items but instead uses user behavior data to generate predictions.

There are two main types of collaborative filtering:

- **User-based collaborative filtering:** Identifies users with similar histories and preferences and recommends items liked by similar users.
- **Item-based collaborative filtering:** Focuses on identifying relationships among items based on user interactions and recommends items that are frequently accessed or selected together.

In practice, collaborative filtering has demonstrated strong performance in online platforms such as Amazon, Netflix, and Spotify due to its simplicity and effectiveness in producing personalized recommendations (Su & Khoshgoftaar, 2009). However, collaborative filtering also faces limitations including sparsity problems—where insufficient rating data leads to weak predictions—and cold start issues, which affect new users or items without historical interaction data.

In an E-Visa system, collaborative filtering can be used to recommend visa categories based on applications submitted by similar users, suggest additional travel documents based on patterns in

previously approved applications, and predict the likelihood of approval based on user nationality and travel purpose. However, due to privacy constraints and lack of historical visa data for new applicants, collaborative filtering alone may not be sufficient, requiring integration with other recommendation techniques.

Hybrid Method

Hybrid recommendation methods combine two or more recommendation techniques to overcome the limitations of individual methods and improve prediction quality. For example, a hybrid system may merge collaborative filtering with content-based filtering to provide more accurate and diverse recommendations.

Hybrid systems are useful because they can address data sparsity, cold start problems, and limited content descriptions that affect standalone techniques. In the context of intelligent systems, hybrid models are popular due to their flexibility and robustness in complex domains where user behavior is dynamic. Research indicates that hybrid recommenders provide improved recommendation accuracy, reduce reliance on single data sources, and enhance system adaptability (Burke, 2002).

In an E-Visa platform, a hybrid approach could combine collaborative filtering to understand common user behaviors with content-based filtering to analyze visa policy attributes, eligibility rules, and document templates. This approach would enable the system to recommend the correct visa category based on both user profile and visa descriptions, while also suggesting personalized document requirements based on the application context. Hybrid approaches also allow inclusion of contextual data such as applicant nationality, purpose of travel, and travel history, making recommendations not only accurate but also compliant with immigration rules.

Recommendation Systems in Educational Environments

The education sector has widely adopted recommendation systems to support personalized learning pathways, reflecting their value in supporting decision-making and improving user experience. Educational recommendation systems analyze learner data to suggest courses, assignments, learning resources, career paths, and academic strategies based on individual performance and learning patterns. These systems enhance student engagement by delivering relevant academic support and reducing decision fatigue associated with course selection.

Studies show that recommendation systems increase student retention in online learning environments by providing tailored study guidance and academic resources (Manouselis, Drachsler, Verbert, & Santos, 2012). The success of recommendation systems in education provides valuable lessons for other digital platforms such as E-Visa systems, where users also

require guidance based on personal attributes and system requirements. Like students navigating complex academic choices, visa applicants must navigate complex immigration rules, eligibility criteria, and document requirements. Integrating recommendation logic into an E-Visa platform could ensure that users receive personalized assistance similar to that offered to learners in adaptive learning platforms.

Course Recommendation Systems

Course recommendation systems are a specialization within educational recommendation technologies designed to help students select appropriate academic modules based on their learning goals, academic progress, and program requirements. These systems consider factors such as prerequisite knowledge, course difficulty, student interests, and historical performance to generate accurate course suggestions. Some models also include peer behavior analysis, where course recommendations are based on the choices of students with similar academic profiles.

Course recommenders help reduce student dropout caused by poor class selection and increase student satisfaction by aligning learning paths with academic ability and career ambitions (Fischer, Chen, & Wang, 2020). The operational logic behind course recommendation systems can inspire an E-Visa recommendation engine. Just as students benefit from structured course pathways, visa applicants can benefit from tailored application pathways that suggest suitable visa types based on profile information such as nationality, purpose of travel, financial capacity, and previous immigration history. Course recommendation systems also warn students about missing prerequisites; similarly, a visa recommendation system can alert applicants about missing documents or eligibility violations.

Extracurricular Activity Recommendation Systems

Beyond academic recommendations, educational institutions also employ recommendation systems to suggest extracurricular activities, student clubs, sports, and volunteer opportunities. The goal of these systems is to promote holistic student development by encouraging participation in non-academic programs that build leadership, teamwork, and personal growth. Extracurricular recommendation systems analyze student interests, hobbies, personality profiles, and participation history to recommend activities that align with personal development goals.

Some systems also incorporate social recommendation features, suggesting activities based on peer participation to increase engagement (Khan, Chou, & Ong, 2017). The logic behind extracurricular recommendation systems parallels visa advisory needs because both domains require user profiling and contextual recommendations. Just as students are guided toward suitable extracurricular options, applicants in an E-Visa system can be guided toward appropriate visa categories, supplementary services like health insurance, and country-specific travel

guidelines. These systems demonstrate how emotional, social, and motivational factors can be incorporated into recommendation engines—suggesting that E-Visa recommendation systems should also consider user satisfaction and guidance clarity rather than only technical eligibility.

Student Support Systems

Student support systems utilize intelligent algorithms to provide academic guidance, emotional counseling, and administrative assistance through digital platforms. These systems analyze institutional policies, student records, and progression rules to deliver accurate academic support and timely reminders. Research indicates that such support systems improve institutional retention and student success by offering personalized mentoring, deadline reminders, and automated academic suggestions (Sharabiani, White, & Ford, 2014).

Similarly, an E-Visa application system enhanced with intelligent recommendation support can act as a decision-support platform rather than a passive data collection tool. For example, it can guide applicants step-by-step, flag potential eligibility risks, and explain immigration requirements in simple language. Like student support systems, visa support tools must reduce user frustration and increase the likelihood of successful application submissions. This highlights the shift from static websites to intelligent decision-support platforms driven by recommendation logic.

Critical Analysis of Existing E-Visa Systems

Although E-Visa systems have gained popularity globally, especially in Asia and Europe, existing platforms reveal significant limitations. Current literature notes challenges such as lack of user guidance, absence of personalization, limited multilingual support, and high application rejection rates due to incorrect data entry (Ilias & Nugroho, 2021).

Most E-Visa platforms operate as static web forms rather than intelligent systems, requiring users to manually navigate visa categories and eligibility rules without personalized assistance. Additionally, many E-Visa systems lack transparency in application status and decision criteria, leading to user frustration and distrust. Studies also highlight system usability issues such as unclear instructions, complex form layouts, and lengthy application processes that contribute to abandonment rates. Furthermore, existing platforms do not support real-time interaction or recommendation services to help users identify missing requirements or improve application quality. These limitations provide strong justification for integrating recommendation systems into E-Visa platforms to support decision-making, reduce errors, and improve user satisfaction.

Data Quality and Availability

The success of recommendation systems depends heavily on the quality and availability of user data. Poor-quality data, missing data, duplicate entries, and inconsistent formats lead to inaccurate predictions and unreliable recommendations. In many developing countries, data collection practices are weak, resulting in fragmented immigration datasets that lack completeness and consistency (Batini & Scannapieco, 2016).

Recommendation systems require structured visa application history, demographic data, behavior logs, and decision outcomes to generate meaningful suggestions. However, E-Visa systems frequently face data sparsity due to new users lacking historical visa records. This makes it difficult to build recommendation models based solely on collaborative filtering. Ensuring data integrity, cleaning historical immigration data, and designing structured input forms is critical to improving recommendation accuracy in visa platforms. Without addressing data quality and availability, any recommendation-enhanced E-Visa platform would struggle to deliver reliable decision support, emphasizing the need for data governance strategies and modular database design.

User Privacy and Ethical Considerations

Integrating recommendation systems into E-Visa platforms raises important ethical concerns related to privacy, surveillance, user consent, and responsible use of personal data. Visa applications often involve highly sensitive data such as biometric identifiers, travel history, employment records, criminal background, and financial statements. This makes E-Visa platforms high-value targets for cyber threats and data breaches.

Any recommendation module that processes this data must comply with international data protection standards such as GDPR and national cybersecurity regulations to prevent misuse of personal information (Floridi, 2016). Furthermore, users must be informed about how their data is used to generate recommendations, reinforcing transparency, and trust. Ethical frameworks must also ensure that recommendation systems do not unfairly profile users based on nationality, ethnicity, or religion, as this could lead to discriminatory treatment. Therefore, privacy-aware recommendation design is essential to maintain fairness, transparency, and trust in E-Visa systems.

User Acceptance and Engagement

For an intelligent E-Visa system to be successful, users must not only understand how to use it but also trust and accept its guidance. User acceptance is influenced by perceived usefulness, ease of use, system transparency, and trust in the recommendation outputs. If applicants perceive

the recommendation system as confusing or intrusive, they may reject its suggestions and continue making errors during the application process (Davis, 1989).

In the context of E-Visa platforms, this means the system must explain clearly why a certain visa category is recommended and how it aligns with the user's goals. Recommendation explanations build confidence and improve trust. An intelligent E-Visa system must therefore incorporate explanation modules, help menus, and interactive guidance to promote user adoption and sustained engagement.

Algorithm Bias and Fairness

Recommendation systems can unintentionally reinforce bias based on the underlying data used to train them. If historical visa approval data reflects political preferences or discriminatory immigration policies, a recommendation system could unintentionally perpetuate bias by discouraging certain applicants or nationalities (Barocas & Selbst, 2016).

Algorithmic fairness is essential when designing E-Visa recommendation modules to ensure equal treatment of users from different regions and backgrounds. This requires bias detection, fairness testing, and training on balanced datasets. Fairness-aware machine learning techniques must be integrated to prevent biased recommendation outcomes. Additionally, system transparency must be prioritized to give users access to appeal mechanisms in case they receive unfair recommendations. Addressing algorithm bias is not only an ethical responsibility but also a legal requirement in many jurisdictions to promote equality in public services.

Addressing Gaps in Existing Research

Existing literature shows that recommendation systems have been successfully used in educational and commercial platforms to improve user guidance and decision support. However, their application in digital government systems—especially E-Visa technologies—remains largely unexplored.

Most E-Visa platforms lack intelligent support, personalization, error detection, and real-time guidance. There is minimal research on hybrid recommendation models for immigration systems, and no significant empirical studies on how they improve visa application success or reduce errors (Zhao, Li, & Chen, 2023). Additionally, previous research in E-Government has focused largely on service accessibility and usability, but not on intelligent automation and personalized user assistance. There is also a gap in integrating ethical AI into visa systems to prevent discrimination and privacy violations.

The proposed system addresses these gaps by developing a hybrid recommendation-enabled E-Visa model that offers personalized visa guidance, document recommendations, eligibility assistance, and transparent user explanations.

Conclusion

This chapter reviewed literature related to recommendation systems, collaborative filtering, hybrid approaches, and their applications in education and digital platforms. It further examined current E-Visa system limitations, highlighting the lack of intelligent support, high rejection rates, and user difficulties in navigating visa processes. Critical issues such as data sparsity, user privacy, ethical risks, user acceptance, and algorithmic bias were also analyzed.

The findings reveal significant research gaps in the field of intelligent visa processing systems, particularly concerning decision-support mechanisms and personalization. This justifies the development of an intelligent recommendation-enhanced E-Visa application system that improves user guidance, reduces application errors, enhances transparency, and increases system usability. The next chapter will present the theoretical and conceptual framework guiding the development of the proposed system.

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CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter presents a detailed description of the research methodology adopted for the design, development, and evaluation of the E-Visa Application System. The methodology serves as the foundation upon which the systematic investigation of the research problem was built. It outlines the overall research design, target population, sample design, sampling techniques, data collection methods, data analysis and presentation procedures, and ethical considerations that guided the entire study.

The methodology ensures that the research follows a logical, reliable, and replicable structure that supports the achievement of the research objectives. Through the chosen methodological framework, the study aims to guarantee accuracy, credibility, and scientific rigor in addressing the research problem.

The primary purpose of this study is to explore how an automated E-Visa Application System can improve efficiency, transparency, and accuracy in the visa processing process. Manual visa systems often lead to long delays, human errors, and lack of data security. Therefore, this study adopts a systematic approach to analyze, design, implement, and evaluate a digital solution that enhances efficiency, reduces paperwork, and improves service delivery.

The methodology integrates social science research and system engineering principles to ensure that both user perceptions and technical performance are evaluated comprehensively. This hybrid approach strengthens the validity of the study, aligning the research process with the development and deployment of the E-Visa Application System.

3.2 Research Design

Research design is the overall strategy that outlines how the research objectives are achieved, how data are collected, analyzed, and interpreted, and how the research questions are addressed. It provides a clear framework that links theoretical concepts with practical investigation.

This study adopted a mixed-methods research design, combining quantitative, qualitative, and System Development Life Cycle (SDLC) methodologies. The integration of these methods ensured that both numerical and experiential data were collected to provide a holistic understanding of the E-Visa system's effectiveness.

3.2.1 Quantitative Research Design

The quantitative approach focused on collecting and analyzing numerical data to measure system performance. It involved structured questionnaires distributed to immigration officers and visa applicants to quantify the system's efficiency, reliability, and ease of use.

Data such as processing time, user satisfaction rates, and error reduction percentages were analyzed statistically to determine the effectiveness of the E-Visa system. The advantage of the quantitative approach is its ability to provide measurable, comparable results. By applying statistical methods, the research identified significant relationships between automation and operational improvements. This ensured objectivity and allowed the results to be generalized across similar administrative environments.

3.2.2 Qualitative Research Design

The qualitative component focused on understanding participants' experiences, perceptions, and attitudes toward the E-Visa Application System. Semi-structured interviews and observations were used to collect non-numerical data, enabling the researcher to explore deeper insights about usability, accessibility, and system trustworthiness.

Qualitative research revealed issues that numbers alone could not explain, such as staff adaptability, perceived security, and the human challenges of transitioning from a manual to an automated process. This enriched the study by contextualizing statistical results with real-world perspectives, creating a complete understanding of the system's performance and impact.

3.2.3 System Development Life Cycle (SDLC)

The study also adopted the System Development Life Cycle (SDLC) framework to guide the design and implementation of the E-Visa Application System. The SDLC provided a structured process that included the following phases:

- **Problem Identification:** Defining challenges in the current manual visa system and identifying the need for automation.
- **System Analysis:** Gathering user and system requirements through questionnaires and interviews to define specifications.
- **System Design:** Designing system architecture, user interfaces, and database structures to meet identified requirements.
- **Implementation:** Developing and testing the system in a controlled environment and refining it based on user feedback.
- **Evaluation and Maintenance:** Assessing system performance and addressing limitations.

By integrating SDLC into the research design, the study ensured that system development was practical, efficient, and user centered. This framework facilitated the transition from theoretical analysis to real-world applications.

3.3 Target Population

The target population included all individuals and institutions directly or indirectly involved in visa application and processing. These included immigration officers, visa applicants, ICT experts, and system administrators.

Each group contributed unique insights into the system's operation and optimization. Immigration officers provided operational perspectives; ICT experts offered technical insights, and visa applicants shared experiences regarding accessibility and user-friendliness. This diversity ensured that findings reflected the needs of both system users and developers.

3.4 Sample Design

The sample design defined how participants were selected from the target population to ensure representative and unbiased data collection. The study aimed for balanced representation across three primary user categories: visa applicants, immigration officers, and ICT personnel.

Participants were selected based on relevance, availability, and expertise. Visa applicants provided user feedback; immigration officers assessed workflow efficiency, and ICT personnel contributed technical knowledge.

A combination of purposive and random sampling strategies was applied. Purposive sampling was used for officers and ICT experts due to their specialized knowledge, while random sampling was used for applicants to ensure fairness and representation. The sample size was sufficiently large to achieve reliability but manageable within the project's timeframe.

Demographic diversity—such as gender, age, education level, and frequency of system use—was considered to ensure inclusivity. Ethical guidelines, including informed consent and confidentiality, were strictly observed.

3.5 Sampling Techniques

Both purposive and simple random sampling techniques were used.

- **Purposive Sampling:** Targeted participants with direct experience in visa processing or system development.
- **Simple Random Sampling:** Ensured equal participation opportunities among visa applicants.

This dual approach provides depth through expert insights and generalizability through random selection, enriching the data, and capturing both technical and experiential dimensions.

3.6 Data Collection Methods

Accurate and comprehensive data collection was central to this study. A triangulated approach—involving questionnaires, interviews, and system observation—was adopted to increase validity and reliability.

3.6.1 Questionnaires

Questionnaires were distributed to visa applicants and immigration officers to collect structured, quantifiable data. They contained both closed-ended and open-ended questions covering topics such as system usability, speed, data accuracy, and satisfaction levels.

Closed-ended questions provided measurable data for statistical analysis, while open-ended questions allowed explanations and feedback. Questionnaires ensured anonymity and were analyzed quantitatively to identify performance patterns.

3.6.2 Interviews

Semi-structured interviews were conducted with immigration officers, ICT experts, and system administrators. These provided qualitative data about system design, security, and integration challenges. Interviews lasted 30–45 minutes and followed a flexible guide to allow new insights to emerge during discussions.

3.6.3 System Observation

Observation involved watching how users interacted with both the manual and automated visa systems in real time. This helped identify inefficiencies, delays, and technical challenges. Observation data validated questionnaires and interview findings, ensuring consistency.

3.7 Data Analysis Methods

Data analysis involves systematically organizing, interpreting, and evaluating the collected data to derive meaningful conclusions. Both quantitative and qualitative techniques were used.

3.7.1 Quantitative Analysis

Quantitative data from questionnaires were analyzed using SPSS and Microsoft Excel. Descriptive statistics such as frequencies, percentages, and mean scores summarize user responses, while graphs and charts illustrate relationships between variables.

Inferential analysis, including correlation and regression, determined relationships between automation and performance indicators like processing time and error reduction.

3.7.2 Qualitative Analysis

Qualitative data from interviews and observations were analyzed using thematic analysis. Transcripts were coded into themes such as usability, security, integration, and user experience. This helped explain user behaviors and perceptions.

3.7.3 Integration of Data

The study integrated both data types to ensure that quantitative findings were supported by qualitative explanations. This mixed-methods approach produced a balanced understanding of the E-Visa system's performance.

3.8 Data Presentation Methods

The data were presented using graphical, tabular, and narrative methods to enhance clarity and understanding.

- **Graphical Presentation:** Visual tools such as pie charts and bar graphs were used to illustrate quantitative data.
- **Tabular Presentation:** Tables organized numerical findings for comparison.
- **Narrative Presentation:** Qualitative results were presented descriptively, supported by direct participant quotations to emphasize key findings.

3.9 Ethical Considerations

Ethical standards guided every phase of this research. Participants were informed about the study's objectives and gave consent before participation. Participation was voluntary, and individuals could withdraw at any time.

Confidentiality and anonymity were strictly maintained. Personal identifiers were excluded, and all data were securely stored. Ethical approval was obtained from the university's research ethics committee before data collection.

The study adhered to the principles of respect, beneficence, and non-maleficence, ensuring that participants were protected from harm and exploitation.