BATANGAS STATE UNIVERSITY
The National Engineering University
Lipa Campus
College of Informatics and Computing Sciences

DEVELOPMENT OF AN INTELLIGENT BUSINESS CARD USING NFC WITH REAL-TIME ENGAGEMENT ANALYTICS

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By

ALMARIO, JOSHUA S.
MISSION, PAUL NIKKO D.
PANOPIO, CHRISTIAN MARK E.

PROF. FRANCIS G. BALAZON, DIT
Adviser

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APPROVAL SHEET

This capstone project entitled **DEVELOPMENT OF AN INTELLIGENT BUSINESS CARD USING NFC WITH REAL-TIME ENGAGEMENT ANALYTICS**, prepared and submitted by **JOSHUA S. ALMARIO, PAUL NIKKO D. MISSION and CHRISTIAN MARK E. PANOPIO**, in partial fulfillment of the requirements for the degree **BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY - MAJOR IN BUSINESS ANALYTICS**, has been examined and is recommended for acceptance and approval for oral examination.

FRANCIS G. BALAZON, DIT
Adviser

Approved by the Committee on Oral Examination with a grade of _____

RYNDEL V. AMORADO, DIT
Chair, Defense Panel

DIONECES O. ALIMOREN, MSCS
Panel Member

RICHELLE M. SULIT, MSCS
Panel Member

Accepted and approved for the conferral of the degree Bachelor of Science in Information Technology - Business Analytics.

RYNDEL V. AMORADO, DIT
Dean, College of Informatics and Computing Science

Date: May 2026

DEDICATION

This work is dedicated to the people who have supported and inspired us throughout this journey.

*To our **parents and families**, your love, sacrifices, and constant encouragement have been our greatest motivation. You stood by us in every challenge, and your belief in us kept us going.*

*To our **adviser, instructors, and mentors**, thank you for your guidance, patience, and for always encouraging us to give our best. Your advice and support have been invaluable in helping us reach this milestone.*

*To **our friends and classmates,** your encouragement and shared experiences have made this journey lighter and more meaningful. Thank you for being there through it all.*

*Finally, to the **Almighty God**, we are grateful for Your guidance, strength, and the courage to overcome every obstacle.*

This work is a heartfelt tribute to everyone who has been part of our journey. Your support has meant more to us than words can ever express.

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Panopio, C.M.E.

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The Researchers

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ABSTRACT

The networking industry and business cards face challenges due to outdated, paper-based techniques that do not allow real-time engagement tracking, dynamic profile updates, or actionable analytics, leading to lost networking opportunities and ineffective lead generation. This paper introduces the OneTapp solution, which overcomes these difficulties by presenting an intelligent business card system that uses NFC technology for real-time engagement analytics, supported by the MERN stack. The essential functions are the secure, contactless exchange of information via NFC cards, the centralized management of professional details, multimedia links, and booking features, and a real-time analytics dashboard for engagement visualization. OneTapp uses data-driven insights to track user activities, including card scans, location data, and engagement metrics, enabling professionals to refine their networking strategies based on current behavior. Thus, the successful execution of OneTapp meets the goal of developing a smart business card system that combines data analytics and modern connectivity to improve networking efficiency, information exchange, and decision-making.

CHAPTER I

INTRODUCTION

1.1 Project Context

In the professional world, which is characteristically digital and fast-paced day by day, there are no two ways about it: effective networking tools must be used to facilitate the building and maintenance of business relationships. Among the various networking methods, traditional paper business cards have always been the go-to. However, they are now less effective for several reasons, including being static, having limited information capacity, and being environmentally unfriendly. Once a paper business card is printed, it cannot be updated in real time; it can easily get lost or thrown away, and there is no way to know how the shared information is used after the exchange, since it lacks metrics.

NFC technology is one of the latest innovations in digital networking tools that has opened up new possibilities like digital business cards, particularly the ones that use Near Field Communication (NFC) technology. NFC allows a quick and effortless transfer of data through a very short range and without any physical contact between devices, thereby making it possible for users to share their digital information rather quickly and conveniently (Syndell Tech, n.d.). The NFC business cards have tackled some major shortcomings of the paper cards, such as offering the ability to update the content, decreasing the amount of paper used for printing, and providing a smooth transition of

information (Tapmo, 2023).

However, on the flip side, most of the NFC business card solutions that are available today still focus mainly on sharing the information and come with no engagement analytics that are real-time integrated. The users usually do not have an idea that the recipients of their profiles did not view them and did not click on the links or take any further actions after a card exchange happened. The lack of measurable feedback hinders the professionals' capacity to assess the influence of their networking actions and, in turn, lose the opportunity to update their strategies accordingly (Uniqode, 2023).

At this point, the potential of NFC-based business card systems that unite contactless information sharing with real-time engagement analytics still remains largely untapped. The gap could be filled by the inception of an intelligent NFC-enabled business card system.

1.2 Purpose and Descriptions

The foremost aim of this undertaking is to create a smart, NFC-enabled business card system with real-time engagement analytics to boost professional networking efficiency and, importantly, support data-driven decision-making. Modern-day networking rituals are made more convenient by introducing NFC technology, which allows digital contact information to be shared securely and instantly without physical contact.

The system proposed in the project allows people in the business to share not only their personal and professional details but also multimedia links and requests for meetings or bookings, all with just one NFC tap. All interactions are logged automatically, capturing engagement metrics such as profile views, card scans, and follow-ups. The data is processed and made available through the web-based analytics dashboard that shows engagement trends in real time.

The system provides users with measurable insights, allowing them to evaluate the effectiveness of their networking activities, spot high-value connections, and, in turn, achieve better returns (ROI) from professional engagements. To sum up, the project envisions a future where eco-friendly, next-generation, analytics-led business cards replace traditional ones.

1.3 Objectives of the Study

The primary goal of the project is to develop and evaluate an intelligent business card system based on Near Field Communication (NFC) technology that performs real-time user engagement analysis. The result would be a more efficient and effective means of professional networking and information transfer.

1.3.1 Specific Objectives:

1. To develop an NFC-enabled smart business card that not only stores but also securely transmits digital contact information, multimedia links and professional

details including features for meeting or appointment requests.

2. To set up a real-time engagement analytics system, which will track user actions like:
   2.1. card scans,
   2.2. location, and
   2.3. engagement
3. To integrate a web-based dashboard for analytics visualization, enabling users to track, analyze, and optimize networking strategies based on real-time data.
4. To evaluate the developed system in terms of functionality, usability, reliability, efficiency, security, and compatibility based on ISO/IEC 25010:2011 as assessed by experts and target users.

1.4 Scope and Limitations of the Study

This section describes the system's aim, its drawbacks, and who can use it. Thus, throughout the project's development, this part played a crucial role in defining the scope and limitations for the researchers.

The research presents the professional and corporate usage of an intelligent NFC-enabled business card system in terms of design, development, and evaluation. The main system features are digital profile management, contactless information sharing via NFC technology, real-time engagement data logging, and access to analytics via a

web-based dashboard.

There are three main parties involved: first, Admins who handle overall management; second, Card Holders (Clients) who handle customization; and finally, End Users who receive the cards. Admins handle system configuration and user accounts, Card Holders personalize their virtual business cards and view analytics, while End Users can view shared profiles by scanning the NFC card with a compatible device. Browsers on mobile and desktop devices grant access to the platform.

The system's entire process is through NFC interactions, and it requires only NFC-enabled smartphones for complete operation. Devices supporting NFC are the only ones compatible; for example, Android smartphones with version 4.0 or later, and iOS devices starting with iPhone 6, can use NFC. Even though there may be a fallback option for QR codes, the system is not focusing on non-NFC interactions, as they are not the primary focus.

Engagement metrics such as card scans, location data, and interaction types are the only real-time analytics available among those that were implemented in the study. Analytics will be accurate to the extent of internet connectivity, device settings, and user permissions. Features like an all-out marketing automation system and AI-based prediction are not part of the current implementation.

1.5 Definition of Terms

This section clarifies the key terms used in the project to help readers better understand concepts and content. While various authors and organizations may define these terms in different ways, the researchers have provided specific definitions based on how they are applied within the context of this project.

Digital Business Card	An electronic version of a traditional business card, allowing individuals to store and share contact information digitally. Usually, it is kept on devices or applications that support NFC and can be transferred instantly through NFC or QR codes. The main advantages of this tool are its versatility, personalization, and the ability to update information without issuing new cards (Syndell Tech, n.d).
Networking	Networking is the term for building and maintaining relationships with people in professional circles that lead to the growth of one's career or business, often accompanied by the sharing of contact

details. The use of digital devices, such as NFC-enabled business cards, makes this process much more efficient by facilitating quick, seamless, contactless information transfer while increasing the likelihood of making new connections (Tapmo, 2023).

NFC (Near Field Communication)

NFC (Near Field Communication) is a short-range technology that wirelessly connects devices for data transfer when they are very close to one another, typically within 10 cm. In the case of NFC business cards, they allow not only immediate but also non-contact transfer of digital information, making the process of exchanging contact details and multimedia content both efficient and convenient (Syndell Tech, n.d.).

Real-Time Engagement Analytics	The real-time procedure of monitoring and studying user interactions with digital content that is shared. When it comes to NFC business cards, this means counting the different actions recipients take with the information, such as viewing, responding, or visiting linked websites (Uniqode, 2023).
Return on Investment (ROI)	A performance evaluation assesses an investment's effectiveness by weighing the profits against the costs. With regard to NFC-enabled business cards, networking efforts are quantified by the number of connections made and engagement level. These measures are part of the ROI calculation, helping users understand the success of their networking strategies (NFC Tagify, 2023).

CHAPTER II

REVIEW OF RELATED SYSTEMS/STUDIES

2.1 Technical Background

NFC (Near Field Communication) is a short-range wireless communication technology that enables data transfer between individuals or devices without physical contact. The distance is typically kept to about 10 centimeters. NFC is widely used across fields such as mobile payments, access control, and digital identity systems. It is a trust-based communication protocol that allows for fast, easy data transfer without requiring contact or additional gadgets.

NFC technology's professional networking application guarantees the easy and efficient sharing of digital contact details. NFC cards can be easily updated, similar to how the content of the card is shared, whereas traditional paper business cards are non-editable and thus occupy a permanent place in the user's wallet or holder. This lets users transmit their data with just one tap, thereby speeding up and making the whole process hassle-free with no more manual input of the data.

For its part, NFC technology was solely used for data transfer. There was no capacity to monitor or analyze user engagement during the period of interaction. The limitation is solved with the deployment of web-based systems and cloud computing technologies. Such a system can provide real-time data storage and synchronization

across devices, enabling the collection and visualization of engagement metrics such as scan frequency, location, and interaction time via online dashboards.

NFC-enabled systems require security and privacy as the most important factors, as they involve the sharing of personal and professional information. Studies highlight the need for secure communication, encryption, and access controls as the main safeguards for users' data when it is transmitted through unauthorized access or interception.

2.2 Related Literature

The literature review synthesizes previous research that supports or contradicts a particular topic and provides the reader with a view of the research and discussions in that area. It assists the researchers in laying a foundation using the already known facts, discovering applicable theories, and revealing the weaknesses in previous research. During the review process, the researchers might narrow their scope to address the limitations of previous studies better. The articles that will be pointed out in this section are the peer-reviewed studies focusing on three important technical areas related to the Intelligent NFC Business Card system, namely secure data exchange, real-time engagement tracking, and scalable system architecture.

Near Field Communication (NFC) Technology in Digital Identity and Business. NFC technology is likely to remain at the forefront of modern communication

solutions, as one of the functionalities that allows easy handling of contactless communication. Besides, there are reports that NFC still is one of the most important features in devices today and draws application usage from its fast, secure payments and data sharing capabilities, ranging from mobile transactions to social media interaction, according to Awais Jawad (2024). Taoglas (2024) confirms the same, stating that NFC is a key technology that provides easy and safe communication through short-range wireless connections.

Smart Business Cards and Digital Networking Tools. Redpanda (2022), The significance of real-time analytics was underscored as it gave the capability to organizations to promptly act on user behavior. Consequently, instant personalization is done to heighten the total user experience. In the same manner, Exasol (2023) delves into the topic by stating that monitoring user interactions in real-time can help discover trends or problems as they appear, which would, in turn, enable organizations to make quicker and more informed decisions.

Real-Time Engagement and Interaction Analytics. In their investigation, El-Ghabouri et al. (2023) reviewed the security threats connected with RFID-based NFC and the security measures that could be applied. They pointed out several vulnerabilities, like interception, noise jamming, and relay attacks, all of which need highly secure authentication systems in order to control the consequences of such threats. Onumadu and Abroshan (2024) also focused on cyber threats faced by NFC payment systems in

relation to defense strategies against such threats. They identified skimming and unauthorized data access as the most common threats and discussed possible solutions like encryption, tokenization, and biometric authentication. The document and other empirical data supporting the same conclusion had also suggested the adoption of a multi-layered security method, which included the technologies mentioned to secure customer data and keep trust in transactions.

Web-Based Systems for Data Storage and Visualization. NFC payments have certain vulnerabilities that demand protection, and Raqib and Rizwan (2020) suggested a cloud-based authentication protocol that not only enhances the security of NFC payments but also provides a variety of other benefits among which the asymmetric encryption plus the cloud-based authentication server that guarantees the secure two-way verification process between the payment devices and terminals, hence stopping the information from being intercepted in the course of the contactless transaction. Likewise, in 2024, Liu et al. did an extensive examination of the near-field communication technology's potential future and not only learned about the progress of NFC in wireless systems but also emphasized the need for precise channel modeling, performance evaluation, and new applications' integration as the main areas of concern. The scientists' final statement is that NFC can significantly improve the wireless networks' performance through the vastness of its capabilities.

Privacy, Security, and Ethical Considerations in Digital Contact Sharing.

Alnfiai (2020) conducted the entire research on his NFC application for children based on a user-centered design paradigm. The study identified the usability of mobile apps according to their age compatibility and the necessary improvements. Therefore, the recommendations for better visual design, improved audio features, more efficient reward systems, and increased privacy and security measures were all data-driven. Ja Razi and Omar (2024) likewise explored the possibility of incorporating NFC tools into the graphic design process in the classroom. Their study revealed that figurative space becomes dynamic and unique in the learning process via the NFC linkage with both physical and digital spheres. A qualitative approach was used to explore the possibility of the technology in inspiring creativity, improving accessibility, and even creating more outstanding user interaction in design-centered environments.

2.3 Related Studies

The intelligent NFC-enabled business cards are capable of providing real-time engagement analytics, which could change the way professionals connect and share information entirely. In addition to being a digital counterpart to paper cards, these smart cards have interactive and personalized features that better integrate networking into the present time. Through the different sources, the response was univocal that NFC business cards have turned the static, traditional sharing of contact information into something dynamic and data driven.

Ripla (2020) is a perfect example as it discusses the marrying of NFC and AI,

which is a step towards making more intelligent and interactive systems. The merging of NFC with AI gives the companies the power to get real-time consumer data for behavior study and strategy modification, hence moving the networks to a more intelligent and precise area. AI analytics, in turn, could provide the business with feedback through studying the user interaction with the business card, and thus, the future interactions would be tailored accordingly. Therefore, intelligence comes along with a single tap.

According to RFID Card Guidance (n.d.), users are able to connect from the card tracking feature to the logging of how many times their cards have been seen and/or shared at most. It has, therefore, to be an issue that gives a huge or at least a very big return in deciding one's outreach strategy. The benefits are shared with the users, and they can use it together with the Customer Relationship Management (CRM) platforms, which help to give a context to any encounter, especially from the tap to engagement and follow-up, in order to create a more personalized follow-up.

NFC business cards are aimed at the development of functions and applications in 2022. Besides their primary purpose of storing and synchronizing enormous volumes of data, the cards can also provide statistics about their usage. With integrated CRM tools, tracking user engagement in real-time was facilitated without any difficulty. In this manner, professionals are shown the successful tactics and are allowed to make the changes. However, all these multifunctionalities together make NFC cards effective and valuable not only for sharing contacts but also for assessing performance.

TAPECT (n.d.) claims that the transference of medium from paper to pixels is coming to pass in the case of business cards, and thus, the gradual process of traditional ones being substituted by digital options that are more intelligent and flexible. Real-time tracking of card usage is offered to the businesses, so they see who, when, and what is going on. Immediate feedback makes networking smarter and more strategic. TAPECT stands for the above-mentioned evolution in the digital world that opens avenues for smart card making that not only shares information but also actively collects it.

Tapt.io (n.d.) offers a comparison among NFC business card providers based on a real-world approach. In this guide, the importance of working with real-time analytics is emphasized as a necessity for any platform that is going to be used, which is likely to be very decisive for most professionals wanting to measure the impact their networking has made. The selection of the correct one not only ensures that the NFC business cards will be aesthetically pleasing but also makes them a source of actionable insights.

The marketing automation systems seem to be integrating these cards as the main thing of GenicCards (n.d.). When combined with CRMs, the NFC cards enable monitoring of connections, the automatic updating of contact records, and the gathering of data that is useful for marketing and networking. This seamless data flow turns the cards into low-cost analytics centers from which the companies can get instant insights and adjust their communication accordingly.

One Good Card (n.d.) talks about the features of NFC cards and notes that their

technology is able to ensure the protection of data while it is stored and sent. The possibility of receiving real-time updates is highlighted as a way for the users to monitor and evaluate the effectiveness of their cards. Data-driven networking cannot do without such insights, as it helps to recognize the most valuable contacts and decide the ideal way to connect with them.

Captello (2020) offers a futuristic perspective on NFC business cards by highlighting digitization and user-friendliness, which enable the cards to automatically log interactions, update CRM systems, and produce reports with no human involvement. The professionals are then able to clean up the mess and, at the same time, get instant feedback on their networking win/loss.

For example, Ingenious Minds Lab (n.d.) provides a technical guide for NFC usage in business card application development. They claim that custom applications can be deployed for data collecting at the interaction, tracking touch points, and real-time updating of the customer relationship management (CRM) system. By each interaction point, organizations can gather and process data, hence the strategies are optimized, and the networking ROI is improved.

2.4 Related Systems

Business cards have undergone a radical transformation during the last few years. The paper strip with the contact information is being replaced by a smart tool, which is

powered by Near Field Communication (NFC) technology, thus allowing the smooth and non-contact sharing of information. Plus, these modern digital cards are much sharper as they come with the capabilities of real-time analytics, CRM systems, and engagement tracking. All these make networking not only easier but also more strategic.

Now, the professionals and businesses can monitor the interactions of their cards, who use them, when, and where, thus turning each connection into valuable data. This information aids in adjusting the promotional activities and enlarging the total impact of the networking efforts. Below are ten interconnected systems created in the last five years that paved the way for the contemporary smart NFC business cards with real-time analytics.

Ripla (2020) is a classic example since it explains the use of data analytics together with NFC to create more intelligent and quicker interactions. The joint effort of NFC makes it possible for companies to get immediate customer data for analyzing the consumers and switching the approach, hence driving networking closer to a more focused area. By means of real-time engagement metrics, the user's interaction with the business card can be recorded, which helps in customizing the next interactions.

Yet, digital business cards have altered professional networking entirely. According to Tagify (2022), the combination of NFC cards and CRM platforms not only enables but also provides professionals with the ability to monitor their networking activities through real-time updates that are automatically synced into their systems.

Captello (2020) draws a picture of the future of NFC business cards, telling how these gadgets not only allow the instant capturing of engagement but also the smooth updating of CRM campaigns. Ingenious Minds Lab (n.d.) reveals the technical side of the building process of NFC business card apps, tracking engagement in real-time, thus providing the users with a seamless and powerful networking experience.

The callback from traditional paper cards to digital ones is a notable leap. TAPECT (n.d.) speaks of this transformation, highlighting the higher interaction level and the tracking ability of the NFC-enabled cards. Tapt.io (n.d.) ranks the different suppliers and, beneath their rating, finds out the ones that offer the most sophisticated real-time analytics features. GenicCards (n.d.) goes further by checking the integration of these cards with marketing automation tools and their capacity to turn each tap into a marketing opportunity that is quantifiable in terms of ROI.

In the paper One Good Card (n.d.), the writer scrutinizes the NFC technology with a microscope and usually clarifies the operation of the technology with its instantaneous data transfer and updates. That means this instant data-driven exchange is what makes smart business cards supported.

2.5 Synthesis

NFC technology, real-time analytics, and professional networking, when combined, are collectively pushing digital business solutions to be smarter, quicker, and

more dynamic. Both the Related Studies and the Related Systems have highlighted that users and organizations are shifting from information conveyance to data-driven interaction.

The studies reveal that NFC-based business cards have evolved from mere digital counterparts of physical cards into powerful engagement tools that can monitor user behavior and connect to the CRM. According to Ridpl (2020) and Tagify (2022), NFC technology will soon be able to interface with CRM systems, enabling highly accurate business transactions through instant feedback and engagement metrics.

By looking at the system, Captello and SmartStore are great examples of using the NFC taps to document very insignificant interactions that might, in the end, influence the strategy-making process right away. This rapidly advancing technology is a clear sign of a trend pushing such systems from simply collecting data passively to actively responding through a behavioral networking platform. Besides the move from paper cards to digital cards, as described by TAPECT and Tapt.io, this also indicates a strong industry-wide need for sustainability, efficiency, and measurable impact.

Another theme that is universally present in the results is the ability to personalize on a large scale. When using NFC technology, end users can transfer data and receive analytics immediately, enabling follow-up actions based on very specific interaction patterns. The GenicCards app, which is part of the Ingenious Minds Lab package, enables businesses to migrate their communication from a broad primary interaction to a very

narrow one.

To put it briefly, the transition from research to practical applications indicates that the future of networking lies in smart business cards, viewed as both a gateway and a feedback loop for engagement. The transformation in communications that are monitored, studied, and turned into practical knowledge through the combination of NFC, real-time analytics, and CRM systems is still in its early stages.

2.6 Conceptual Framework

This project aims to drastically change the way professionals network through a smart, NFC-enabled business card system with live engagement metrics. The system will be several steps ahead of the traditional non-digital business cards, as the latter are just temporary contact exchange, while the former uses NFC technology to offer a truly dynamic and data-driven facilitation of networking. The whole process gets underway from the NFC-enabled business card - with a simple tap, the user is able to share his/her professional data straight away.

Each interaction yields data that embodies scan frequency, location, and engagement time. The Real-Time Tracking module, which documents every user interaction, garners this data. The Web-Based Analytics module then systematically processes this unrefined data, turning it into invaluable insights that help users understand the degree of access and engagement of their contact information by third parties.

Key indicators that are being monitored are the scan frequency, indicating how much of the NFC card is accessed by different devices, the location data, which denotes the place of networking, and the engagement time, which is an indicator of the level of user interaction and thus of interest. Users have access to these metrics through a web-based interface, which allows them to visualize the real-time analytics by means of interactive graphs, heat maps, and timelines.

In a way, the dashboard allows users to have a clear view of their networking events and to evaluate the effectiveness of their interactions. The insights gained from this analysis can help users to pick up the right moment to reconnect with their contacts, adjust their networking strategies, and target the interactions that yield the most profits. With ongoing data gathering and immediate input, this system supports professionals in pushing their networking activities further.

The combination of NFC technology and real-time analytics enhances user engagement and, at the same time, enables the collection of useful data that improves networking strategies and professional relationships.

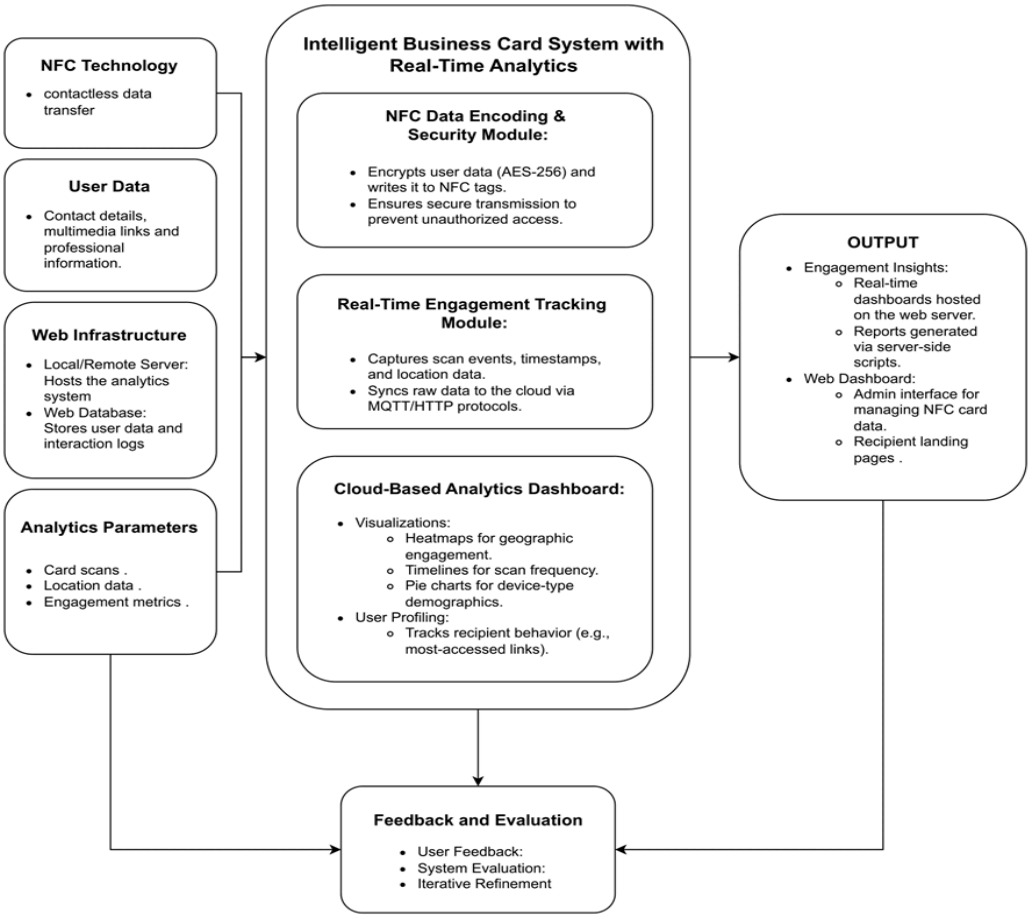

Figure 1. Conceptual Framework of the study

The Conceptual Framework of the system is illustrated in Figure 1. An NFC-enabled online-based card platform for intelligent applications has been created that changes and makes the professional networking process easier. It all starts with the user: this person encodes his contact information, digital portfolio, and relevant links, and writes them on an NFC-enabled card. The information is then securely transferred to

another device as soon as the card comes into contact with a compatible smartphone. The Engagement Tracking Module captures this direct interaction in real-time. All aspects of the interaction, such as scan frequency, time, place, type of device, and interaction duration, are recorded. The data is then sent to the web-based analytics dashboard, where users can see the networking activity directly through interactive visuals such as timelines or heatmaps. The system's Security Module ensures that the data transmissions are encrypted with high security, and at the same time, access is controlled. It is very important to not only inform each other of their respective contact details but also to present the user with the right knowledge to realize how well their networking is, so improvement actions can be directly based on the actual engagement patterns.

The system employs NFC and real-time analytics in a very easy manner to significantly improve digital networking. By tapping the NFC card, sharing of information and media links occurs simultaneously while engagement data, such as frequency of scanning, location, and duration of interaction, is collected and processed through real-time tracking modules. The web analytics dashboard gets Insights from the Engagement Tracking Module so that users can analyze the trends and then change their networking strategies accordingly. Finally, a user feedback and system evaluation module collects feedback on usability and performance for the continuous improvement of both the interface and data accuracy. It results in a smoother contact exchange process, more powerful engagement insights, and smarter, data-driven networking choices.

CHAPTER III

DESIGN AND METHODOLOGY

This chapter covers various aspects of the project concerning the design and methodology that were applied in creating the Intelligent Business Card with NFC and Real-Time Engagement Analytics. The chapter unveiled certain concepts, development models, system designs, and requirements, as well as the trade-offs that were considered in design and implementation. In addition, the chapter outlines the methods for testing and evaluating the system, the plans for its deployment, and the strategies for maintaining it that will together ensure the system's effectiveness and sustainability.

3.1 Project Concepts

NFC-activated digital business cards are being innovated as a way out for one of the problems facing paper business cards: a lack of dynamic, real-time engagement analytics suitable for professional networking capture. The main bottlenecks to a successful business networking experience, according to professionals and industry stakeholders' observations and interviews, are the inefficiency of too many steps in networking, the unavailability of engagement data, and environmental issues. The NFC solution technology implementation, along with the digital medium, is aimed at the most seamless information transfer between the involved parties and thus the secure sharing of contact details, audio-visual links, and brand elements by simply tapping. The built-in

analytics cover not only the interaction of the card but also the engagement metric and geographical data tracking from which the users can extract important information about the effectiveness of their networking efforts. However, like the earlier investigations, NFiD: An NFC-Based System for Digital Business Cards has shown that such systems can support instant contact sharing, secure cloud storage, and the integration of contact management applications. Thus, somewhat of a promise to the project is given regarding the NFC-enabled business cards.

In this project, a web dashboard is indispensable, as real-time analysis and visualization help the user to track and optimize his/her strategies effectively. On the other hand, the project is based on sustainability and personalization; therefore, the users have many chances to customize their digital business cards, though the environmental impact will be less. During the whole process of data transit and storage, security measures will be implemented so that data remains completely confidential. The system was also built to be scalable in view of the forthcoming features like AI analytics and predictive networking tools, and CRM integrations.

Thus, this Simulator of Intelligent NFC-Based Business Cards keeps changing the scenario of professional networking. The system unites the convenience brought by the NFC technology, the dynamism of analytics over the time period, and the environmentally friendly aspects of digitalization into a powerful tool for professionals to

revamp their networking efforts: a modern solution to all the problems being faced due to the use of traditional paper networking systems.

3.2 Development Model

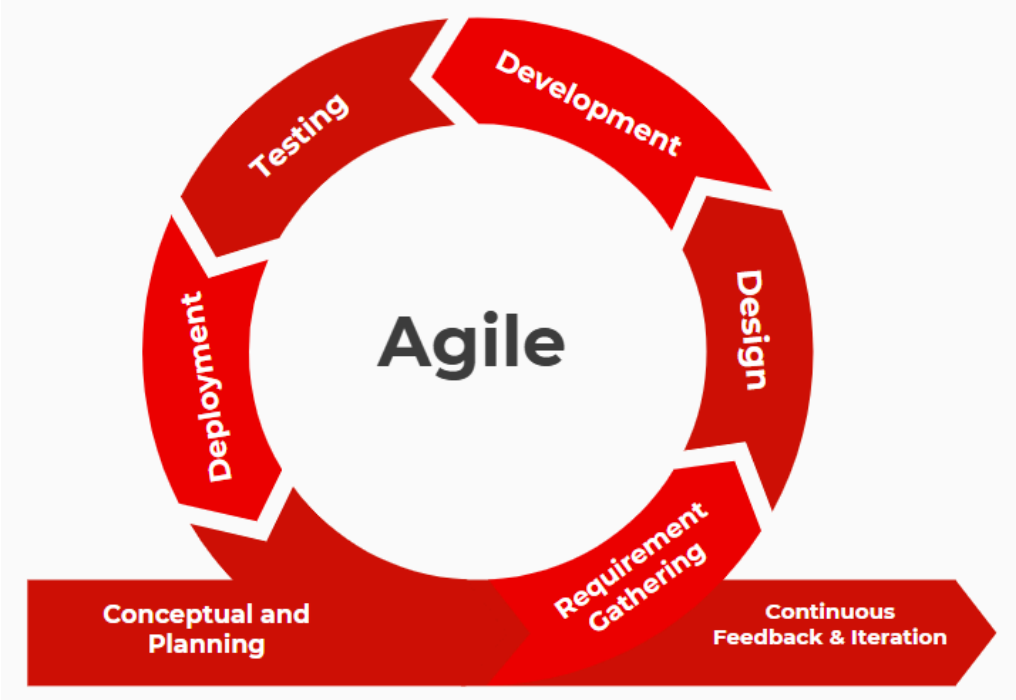

Figure 2. Agile Development

The Agile development methodology, referred to as the figure, has been used for the Intelligent Business Card NFC system, where work goes through short cycles that are repeated instead of a single linear path. Requirements are collected and planned, and then the system is designed, developed, and tested in very small increments, whereby each iteration results in a functional improvement that is ready to be deployed and reviewed by

the users. The stakeholders' feedback is collected continually in every cycle, which enables the team to quickly adjust their priorities and feature refinements, thus making it very appropriate for the systems that demand real-time analytics and frequent user-experience updates.

The project aimed to create a high-tech NFC business card that would be able to record user interaction immediately. One of the main concerns was the reliability of the data that would be collected during the taps, the accuracy of the geospatial tracking, and the usability of the interactive dashboard. The marketing and IT stakeholders were the ones who made the conditions for the project clearer by specifying that sustainability, scalability, and security must be the three pillars of the project, which are not to be compromised. The requirements were gathered with the help of interviews and benchmarking, prioritized using MoSCoW: must-haves (NFC tap-to-share, real-time logging, basic analytics), should-haves (geospatial tracking, RBAC, CRM integration), could-haves (AI suggestions, dynamic content), with offline deferred. Non-functional priorities were identified as strong encryption and Web-native architecture.

The technology stack makes full use of MERN: for trend and heatmap display, React with Chart.js is used; NFC scan event handling is handled by Node/Express; real-time updates are via Socket.io; and MongoDB Atlas with 2dsphere indexing handles geospatial queries. Two-week sprints were divided into the following parts: tap-to-share, then JWT auth and RBAC, then the real-time updates via Socket.io and change streams,

followed by geospatial queries with $near, and culminating in the interactive dashboard.

The tests were made on NFC logging unit tests, real-time data flow integration, performance simulations with over 100 users, and UAT of dashboard insights. The deployment ran on cloud hosting with MongoDB Atlas, and GitHub Actions is used for CI/CD, with automated monitoring for stability and performance. After the launch, in-app surveys, analytics, and beta cohorts were used to drive the iterative improvements; biweekly hotfixes took care of problems like occasional Socket.io drops. The quarterly updates provided follow-up reminders and dynamic NFC content, thus improving retention and speeding up geospatial indexing. The outcome is a platform of secure, scalable, and user-oriented NFC card that reveals data of engagement that can be acted upon and can still be integrated with other CRM tools, as a future enhancement, for instance.

3.3 Requirement Analysis

The old-fashioned way of communication is still using paper cards, which require manual labor for handling, entry into the CRM system, which leads to delays, mistakes, and wastage (billions printed, most discarded quickly). Digital stopgaps such as QR codes or independent apps (LinkedIn, HiHello) are more convenient, but they disrupt the natural flow: QR needs a camera and good lighting, and apps do not connect a physical gesture with an immediate, trackable sharing.

Our NFC business card system seals the gap with tap-to-share from a physical card, instant redirect to a live profile, and built-in analytics. Each scan is recorded in real-time along with engagement signals (taps, clicks, geospatial context), profiles are updated without reprints, and Card Owners/Admins receive actionable insights and control that are not available from either paper cards or ad hoc digital tools.

The limitations of current systems can be categorized across several key areas:

Follow the correct format of table

Table 1. Current Practice and Challenges

Area	Current Practice	Challenges
Networking Efficiency	Physical Exchange of paper cards; manual CRM/data entry.	Errors in manual input; no tracking of follow-ups or engagement rates.
Data Management	Contacts stored in paper cards, apps, or siloed CRM systems.	Fragmented data; no centralized analytics or automated updates.
Environmental Impact	~10 billion paper cards produced yearly; 88% discarded within a week.	Deforestation (~2.5 million trees/year); landfill waste.
User Experience	QR codes require camera alignment; apps lack physical interaction.	Poor usability in low-light conditions; impersonal digital exchanges.
Analytics	No built-in tools to measure networking success.	No insights into scan frequency, geographic hotspots, or ROI.

The proposed NFC-based system is made up of three major innovations that directly meet these requirements. Firstly, NFC technology makes it possible to transfer

information by simply tapping, which in turn takes away the need to type in data while still keeping the face-to-face interaction professionals appreciate. Secondly, a cloud-based analytics system provides tracking through scan frequency, location, and user engagement in real-time. Thirdly, the system works together with the presently used CRM software by means of API connections, which guarantees that the system is in line with the organization's workflow and that data is safe.

3.4 System Design

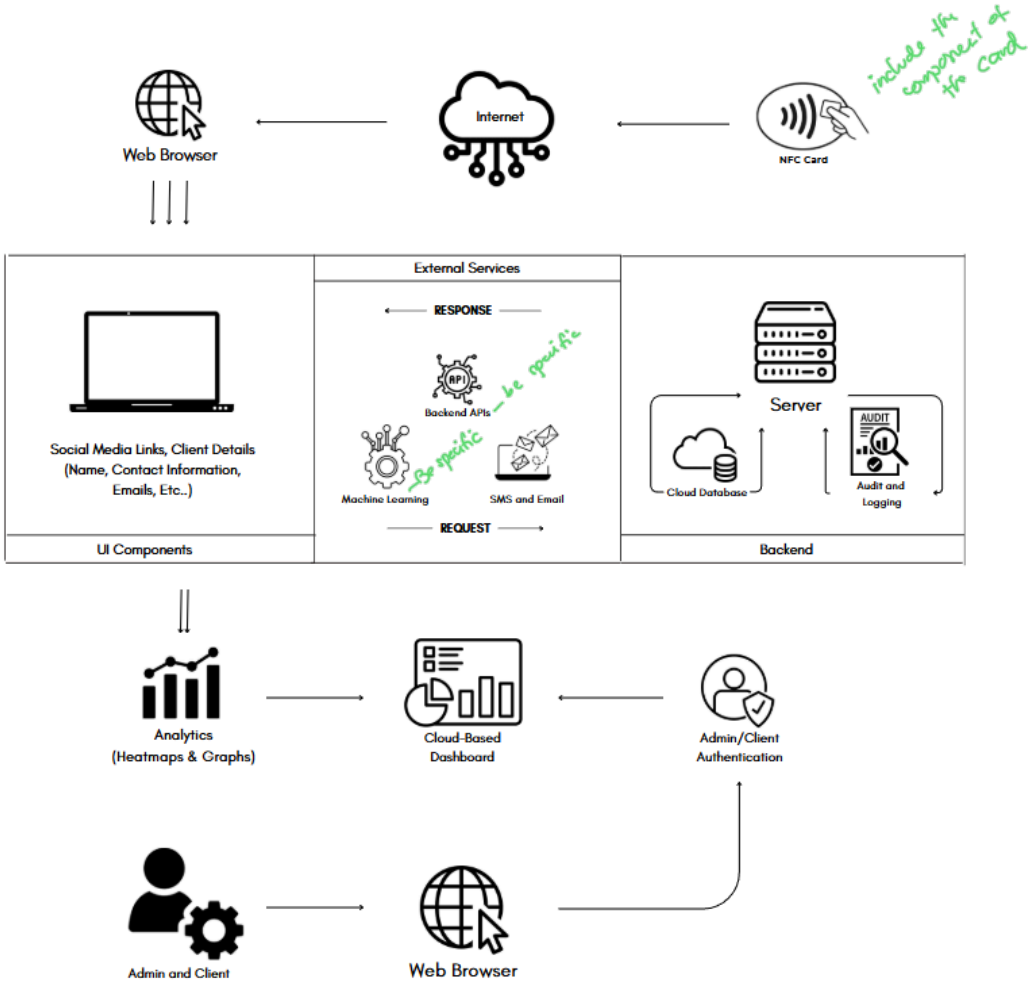

Figure 3. System Architecture Diagram of the project

As shown in Figure 3, the system architecture for the NFC-enabled smart business card integrates hardware, software, and cloud services completely to make a networking solution that is secure, scalable, and data-driven. The vintage business cards are thereby transformed into kinetic objects for contemporary professionals through the system's bridge between the real-world actions and data visualization.

The beginning of any interaction will be at the frontend with the NFC-enabled card as the very first point of contact. The dynamic URL embedded in each card is stored in the NFC chip, providing immediate access to a digital profile with just a tap. A QR code is provided as an alternative for users without NFC-compatible devices, ensuring the solution's universal accessibility. The users of both the NFC and QR options will be taken to a web-hosted profile page that is accessible from any modern browser. The page will display contact information and related details, along with videos and professional details as multimedia content, while the JavaScript-based tracking will record the user's interactions, including click-through rates and engagement duration, which will be analyzed for engagement purposes.

The backstage portion is represented by the backend as the domain of the primary system logic. All NFC scanner requests are directed via an API gateway to the corresponding services from dashboard queries. The backend takes care of the auxiliary functions such as user authentication via OAuth 2.0 or Firebase, and implements A/B testing for optimizing the profile layout. It also provides machine learning insights. The historical engagement data is sent to the machine learning engine, which then processes the records and recommends the best times for networking and improvements on the profile, thus adding another learned intelligence to the system.

Data at a very basic level, combined with such a mix of SQL and NoSQL database types, becomes available for handling huge data volumes more flexibly and

efficiently. A NoSQL database that is employed to keep unstructured data like user profiles, scan events, and multimedia links can be either Firestore or MongoDB. The structured data, on the other hand, can be managed by PostgreSQL, which is the database for audit trails and support tickets. Real-time analytics monitor scan event metrics (e.g., geographical coordinates, device type, and scan time), which are instantly streamed to the dashboard through WebSockets or MQTT for metric visualization.

A sum of external services is included in the architecture to augment its features. The users are notified instantly when their cards are scanned via external APIs like SMS or email (for instance, Twilio or SendGrid). YouTube or Vimeo are among the video markets from which content can be embedded to host videos on user profiles, while help requests and feedback will be managed using effective tools like Zendesk or Jira.

The dashboard is the top of the stack and acts as the primary interface for analytics as well as systems management. In the meantime, users are provided with a clear understanding of networking performance through the availability of interactive visualizations like heatmaps, time-series graphs, and engagement summaries. The administrators' role-based access allows them to control NFC settings, monitor A/B testing, and gather user feedback, while the individual users are given the right to check their engagement metrics and profile optimization accordingly.

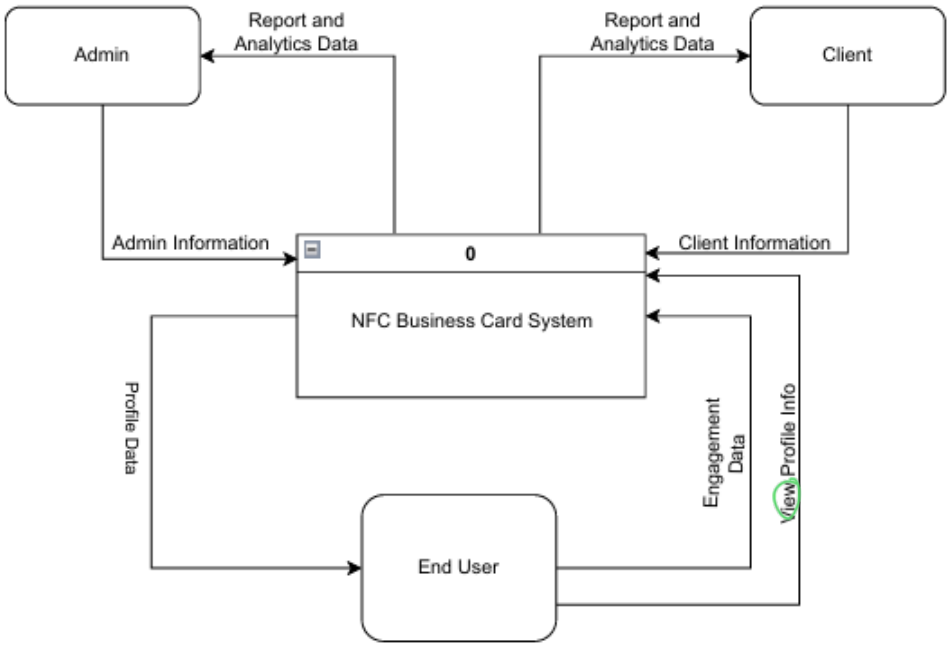

Figure 4. Context Flow Diagram of the System

The Context Flow Diagram for the NFC Business Card System is depicted in Figure 4 and shows the smart, real-time engagement and admin control among clients and end users. The system uses the latest NFC technology, thus enabling anyone to easily exchange digital contact details and profile information while at the same time monitoring and managing all the interactions and profiles, thereby bringing real-time analytics into the picture.

The Admin guarantees smooth sailing for any organization. He will take care of all user management, system configuration, data security, and data integrity. The reports produced will be aggregated by the Admin, who will assign the duties to the users, and

this will feed into a strategic decision to be made regarding the conduct of users within the system.

A custom NFC card is primarily used for the digital presence of professionals or company representatives. The user can adjust the personal or business information depending on the profile or the card settings. The analytics are available for the user to see how many people are engaging with their profile. The system notifies the user every time there is interaction with the card so that the user knows there is a possible lead or connection.

The individual who scans the NFC card most often is the end user, a potential contact, customer, or partner. By scanning, they are directed to a digital profile that includes contact information, social media links, or any other content that has been shared. The system automatically logs all their interactions such as clicks and feedback, these will then be provided as hints to the Clients on how to adjust their presentation and establish a better connection next time.

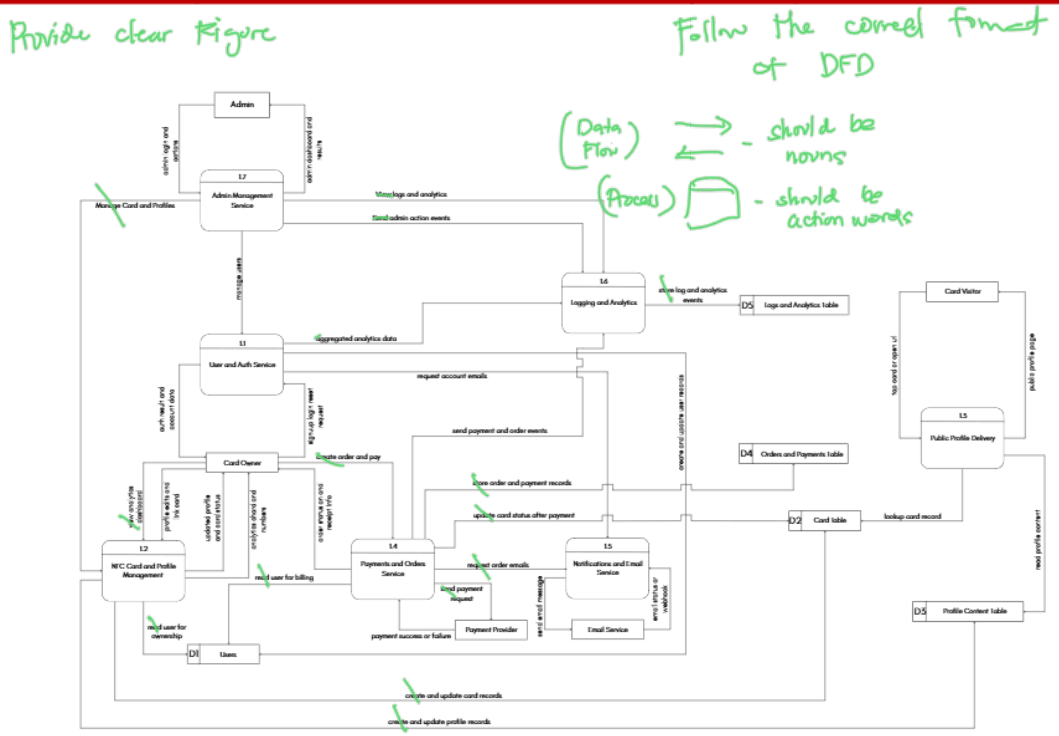

Figure 5. Level 1 Data Flow Diagram of the System

NFC Card Platform services three users: Admins, Card Owners, and Card Visitors. The User & Auth (1.1) system employed by Admins and Card Owners categorizes access to the system depending on the roles, but at the same time allows Card Visitors to see the public content without going through the authentication process. When the visitors either tap the card or enter the URL, they trigger a request to the Public Profile Delivery (1.3) that identifies the card in DB2, obtains the profile content from DB3, delivers the public page, and records taps/views into Logging & Analytics (1.6), which resides in DB5. The Card Owners function with the NFC Card & Profile Management (1.2) whenever they have to make changes to the bios, headlines, links, and

card settings, and the updates are shown instantly to all the visitors. Through Payments & Orders (1.4), users are able to create and manage their orders, communicate with the Payment Provider, have transactions recorded in DB4, and have card status changes in DB2 made if the payment is successful. The analytics dashboard for Card Owners is obtained via the request of 1.2 for aggregated metrics from 1.6, which is connected to DB5 for reading. Through Admin Management (1.7), admins carry out their functions by overseeing users and cards, adjusting the settings such as redirect URLs or activation status, and analyzing the data from DB5; their actions are also logged. Notifications (1.5) take care of the dispatching of verification/reset messages from 1.1 via the Email Service, as well as receipts or order emails from 1.4, with the option of marking the delivery status in DB5. Routing key events, auth, card/profile changes, taps/views, payments, and admin actions through Logging & Analytics (1.6) into DB5 secures and traces the whole process, whereas public pages are still read-only for guests, and the authenticated dashboards are still limited to Admins and Card Owners.

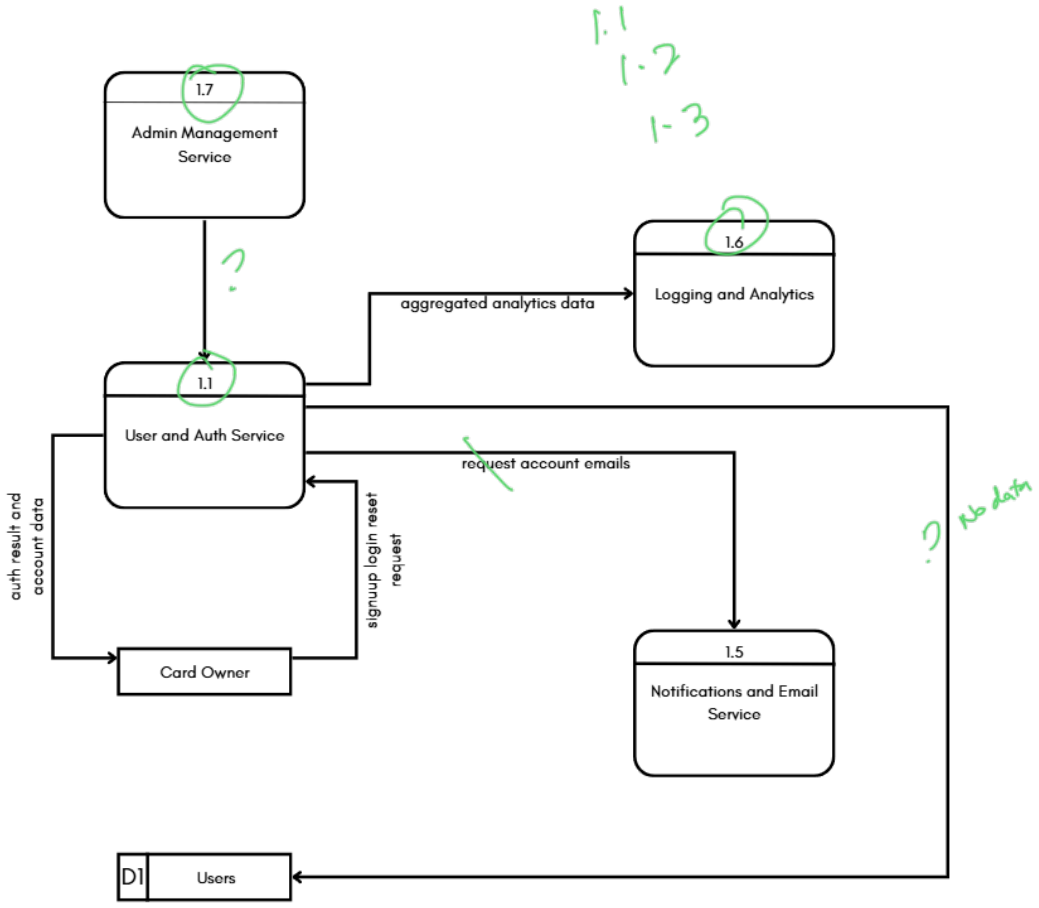

Figure 6. Level 2 Data Flow Diagram of Process 1.0 User and Auth Service

The Data Flow Diagram of Process 1.0 User and Auth Service at Level 2 is shown in Figure 6. The system checks the provided input for validity, searches the user table for the user, then confirms the passwords or tokens, and finally grants or denies a session/JWT whenever a Card Owner or Admin requests signing up, logging in, or resetting credentials. Besides, it changes the account/session fields in the user table, turns on verification or reset emails through the notification service, and logs and stores auth events (success, failure, lockouts) in the logs and analytics store.

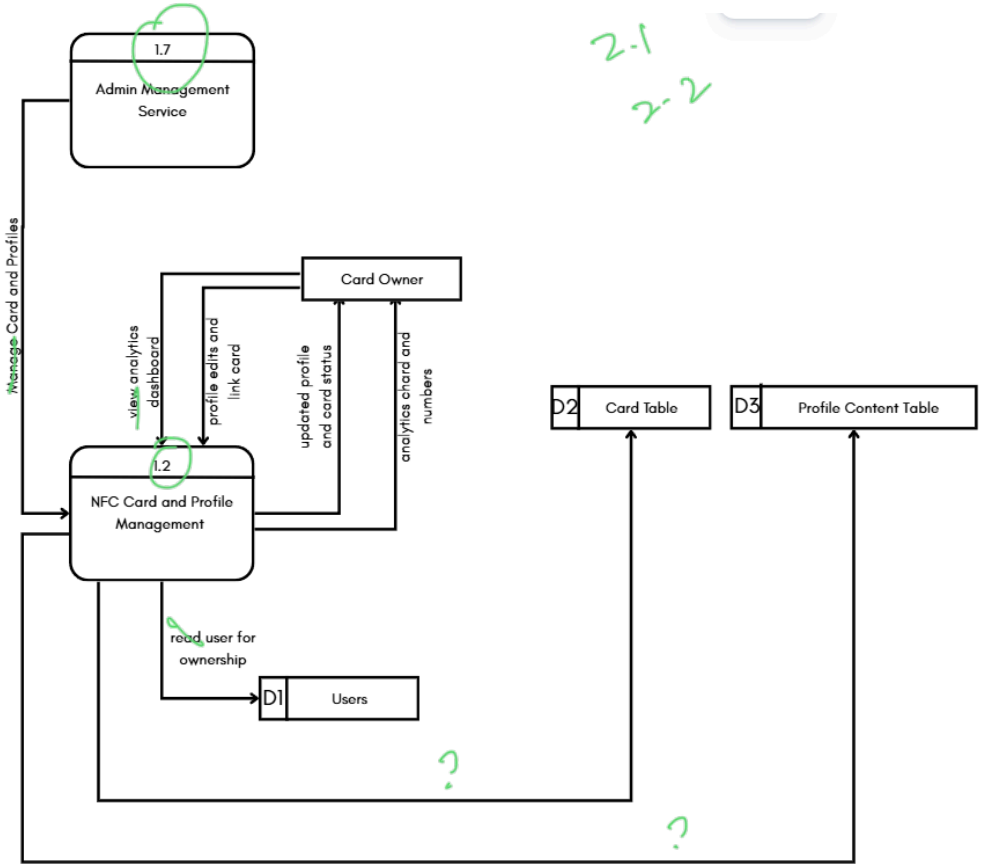

Figure 7. Level 2 Data Flow Diagram of Process 2.0 NFC Card and Profile Management

The Data Flow Diagram of Process 2.0 NFC Card and Profile Management at level 2 is depicted in Figure 7. If a Card Owner or Admin sends any profile or card change, the system first checks the user's ownership and permissions through the user table, and then the card records in the card table and profile content in the profile store are either made or updated. It performs a check of links, text, and media references, and if they are all fine, it makes them permanent. The system logs every activity, both

successful updates and validation/permission failures, in the logs and analytics store. Card Visitors are those who can see these changes immediately when they scan.

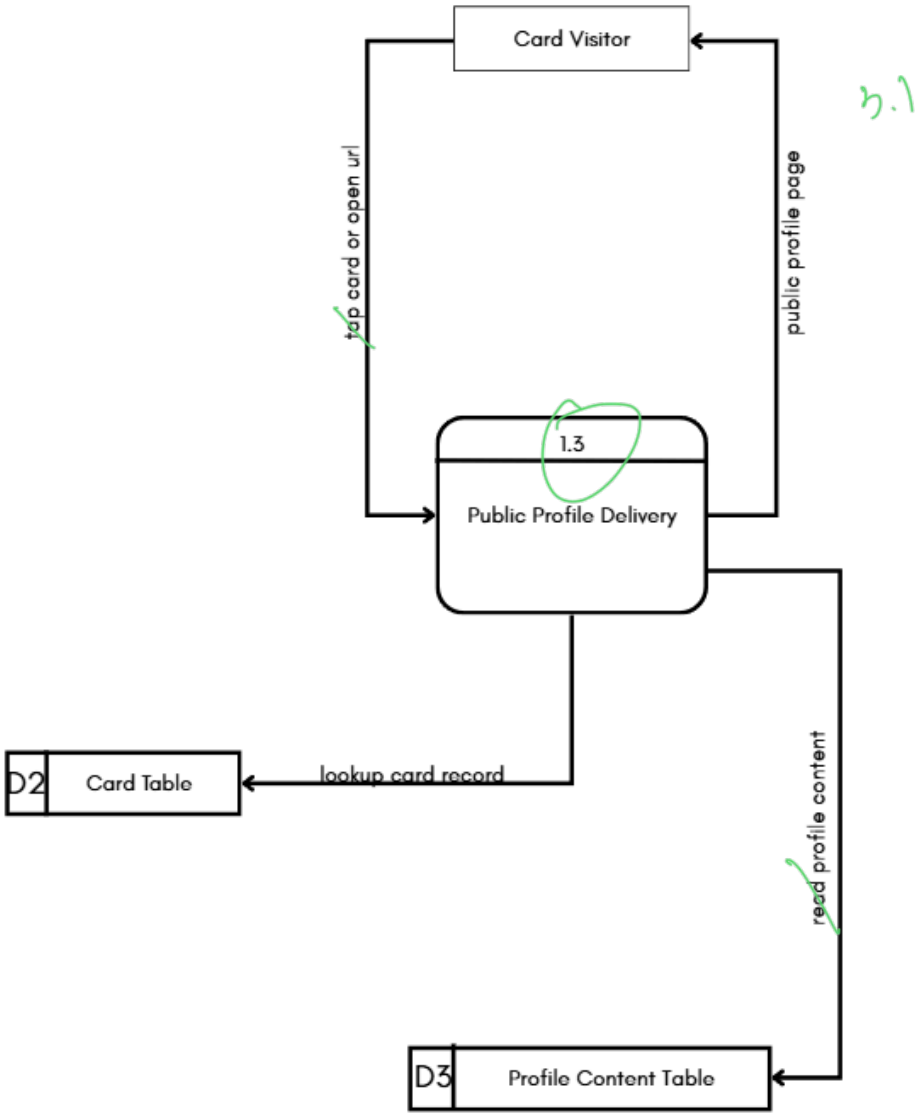

Figure 8. Level 2 Data Flow Diagram of Process 3.0 Public Profile Delivery

The Level 2 Data Flow Diagram for the Public Profile Delivery Process 3.0 is presented in Figure 8. The system recognizes the card by reading its ID or slug when a Card Visitor interacts with his/her NFC card or its URL, verifies the card's state in the card table, and then retrieves the associated profile content from the profile store. If the profile is public, the customer will be sent to the public profile page; if the card is disabled or not found, an error page will appear instead. The scan time, IP/device, and optional location are stored in the logs and analytics database, and each scan captures that information; additionally, link clicks and other user interactions on the profile page are also recorded for engagement tracking.

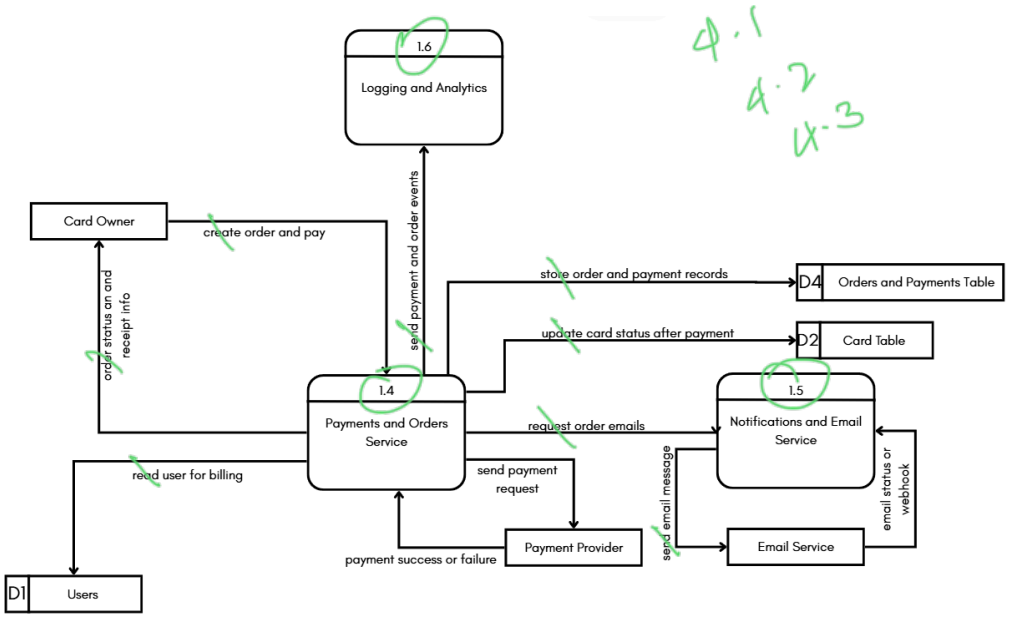

Figure 9. Level 2 Data Flow Diagram of Process 4.0 Payments and Orders Service

The Level 2 Data Flow Diagram for the Payments and Orders Service process 4.0 is shown in Figure 9. Once a Cardholder places an order, the system not only creates an order record in the orders/payments table but also initiates the checkout with the payment provider and returns either a payment link or a client secret. Payment status is reflected through the provider's webhooks or callbacks, and, if the transaction is approved, the system will either enable or modify the card status in the card table and might also upgrade the user's status in the user table. These actions are carried out quietly, though the owner is still informed, and notifications are sent out with receipts, not to mention that all payment/order events are kept in the logs and the analytics store.

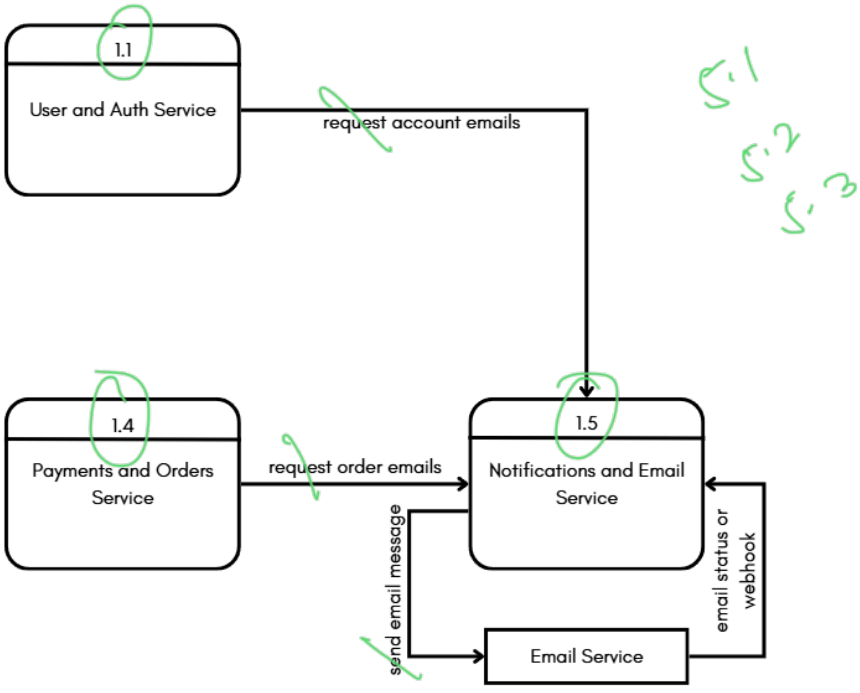

Figure 10. Level 2 Data Flow Diagram of Process 5.0 Notifications and Email Service

Figure 10 illustrates the Data Flow diagram at Level 2 for Process 5.0 Notifications and Email Service. When emails (verification, reset, receipt, or other notifications) are requested by other services, the system selects the correct template, prepares the message payload, and sends it via the email service. The delivery status or webhooks can be recorded and stored in the logs and analytics store, while errors can optionally be pointed out to the requester.

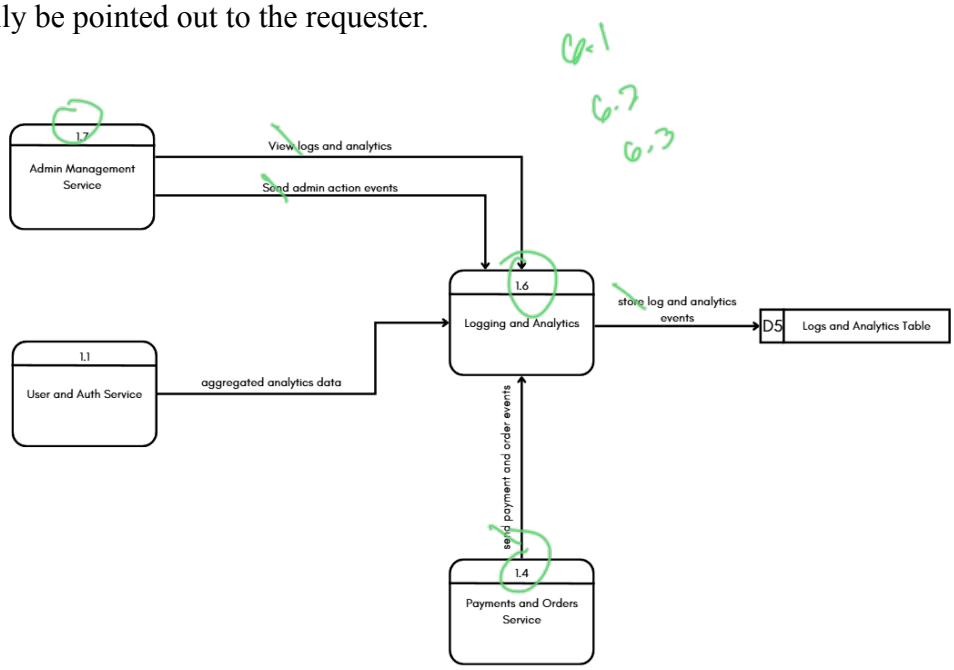

Figure 11. Level 2 Data Flow Diagram of Process 6.0 Logging and Analytics

Figure 11 illustrates the Data Flow diagram at Level 2 for the Process 6.0 Logging and Analytics. The moment an event occurs in any of the services (for instance, authentication, alteration of card/profile, scanning/viewing activity, payment, or admin actions), the system first normalizes it and then adds the timestamp and identification

information before archiving it in both the logs and the analytics table. The events saved can be utilized as the main source for giving aggregated analytics to the requesting services, for creating reports, and even user-friendly analytics dashboards for Card Owner through card/profile management or Admin through admin management.

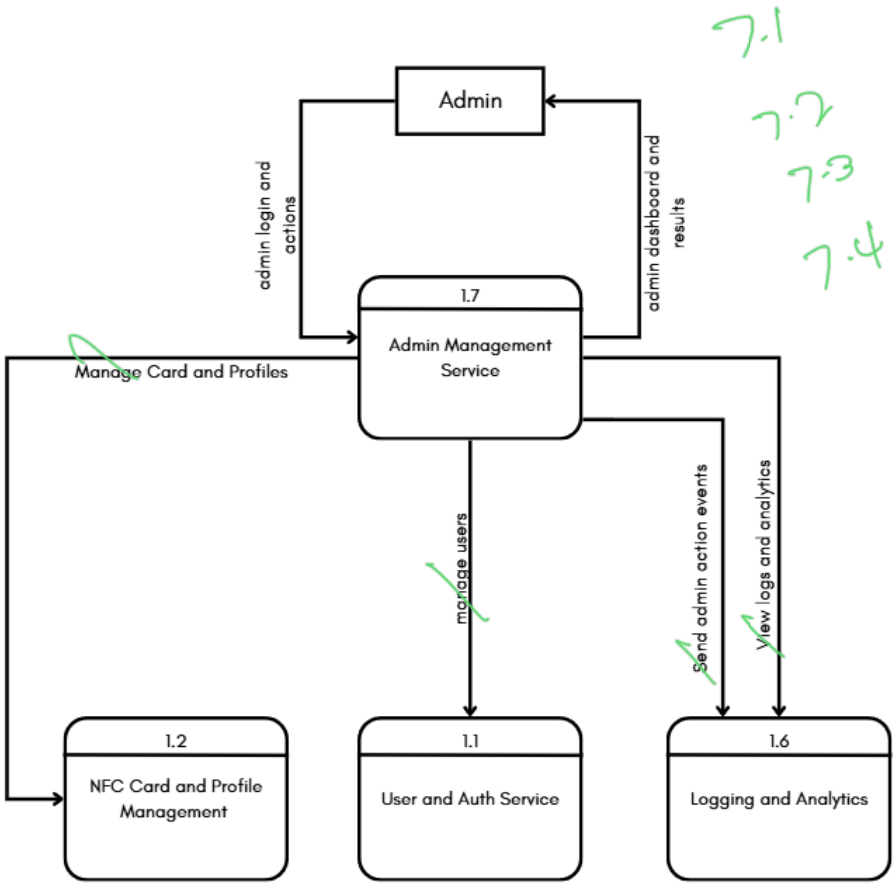

Figure 12. Level 2 Data Flow Diagram of Process 7.0 Admin Management Service

Level 2 Data Flow diagram for Process 7.0 Admin Management Service according to Figure 12. As soon as an Admin gets into the system via the authentication

service and uses the system for various functions, the system permits the management of users in the user table, moderation of cards and profiles through the card and profile stores, changes to the configuration and execution of analytics queries supported by the logs and analytics store. All admin actions are logged and archived in the logs and analytics store as events, which ultimately supports the traceability of all admin changes.

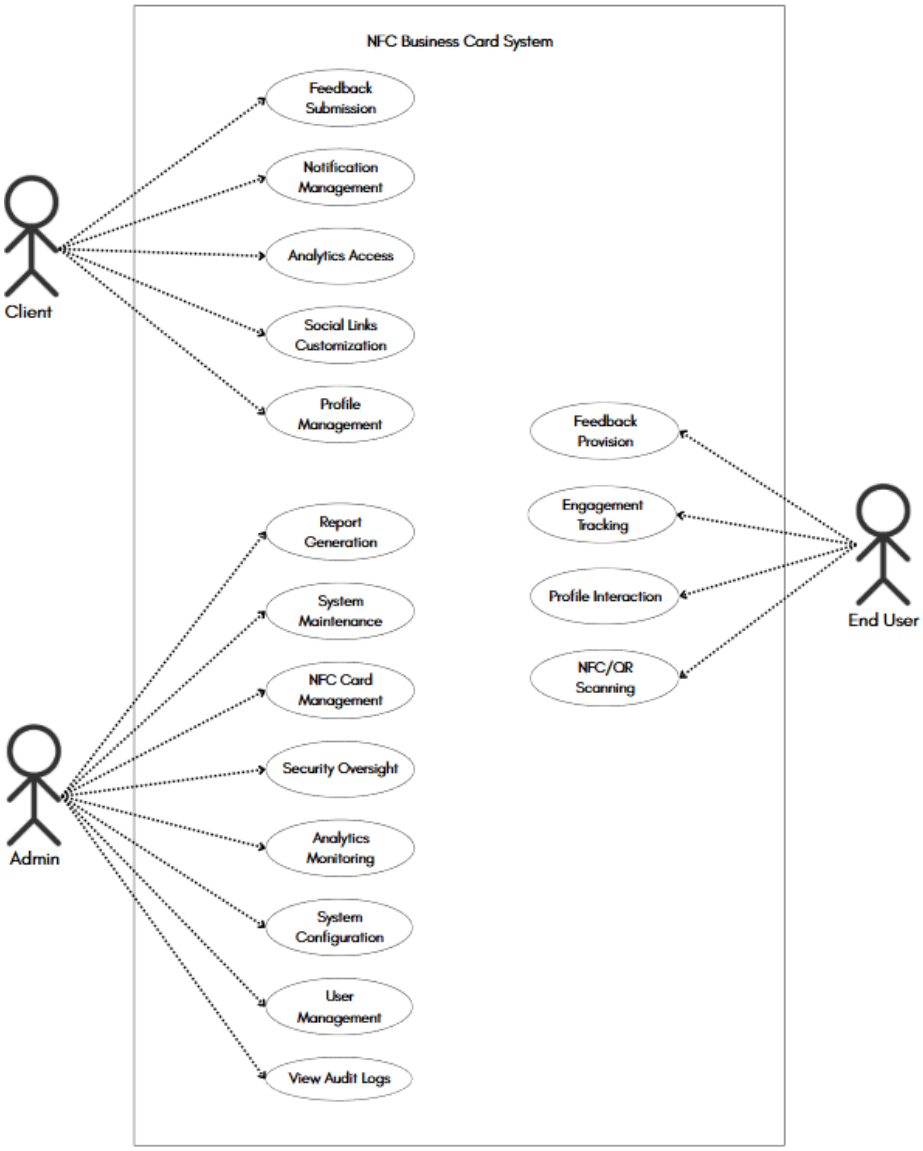

Figure 13. Use Case Diagram

The diagram of use cases for the NFC Business Card System portrays the interactions of three actors, namely Client, Admin, and End User, with the system to perform different activities. The Client, who is usually a business owner or an

organization, configures and maintains digital business cards, manages profiles, and sees usage-tracking analytics through the system. The Admin is responsible for the overall functioning of the platform, which includes user account management, system security control, operations monitoring, and audit log reviewing to ensure that the environment is stable and compliant. The End User comes into contact with the NFC card by means of a scan to reveal the information shared, interacting with the profiles, and possibly posting comments about the experience. The diagram, in unison, casts the boundaries of the system and indicates the primary services provided to each actor, thus giving a lucid, top-level view of the system's functional requirements without delving into the technical implementation specifics.

The NFC-enabled business card system operation consists of three main actors: the admin developers, the customers, and the end users, thus leading to the creation of a use case diagram for the system.

The administrative developers are responsible for the system's infrastructure installation and maintenance, embedding dynamic URLs into NFC cards, managing the encryption of data transmission, and resolving all issues related to system performance. They also provide real-time analytics from a central dashboard, including scan frequency and geographical activities, and they meet a range of data privacy regulations, from GDPR to CCPA.

Microbusinesses, corporates, or even individual professionals can manage their profiles locally. They have to provide their contact details, media links, and professional content during the sign-up onboarding process, which can be modified anytime by the user. Firms are then provided with reports on user engagement via the dashboard, which tells them about the interactions of end users with the company's profiles, and this information can be used to get the content and networking strategies even better.

The end users utilize their smartphones or other devices like tablets to scan an NFC-enabled card, which leads them to a digital profile of the client where they can see the client's contact information, videos, and portfolios. The client is notified in real time for every scan via SMS or email, so quick follow-up is facilitated. End-users are generally inactive participants, but since their behavior and actions lead to the generation of anonymously collected data, their actions are continuously analyzed to recognize patterns and give insights to the clients.

The system makes use of third-party services for multimedia hosting and notifications, which in turn lessens the amount of manual work required. Data security continues to be a major issue and a priority, with one of the main areas of focus being the safeguarding of sensitive data against intrusions by means of encrypting at rest and employing secure transport protocols. The whole attached ecosystem is able to transform the straightforward swapping of business cards into a well-informed and data-driven

encounter with myriad opportunities for conducting richer relationships that eventually give rise to fruitful growth.

3.4.1 Software Requirements Specifications

The system shall include features such as contact sharing through NFC, provision of engagement metrics, and the creation of an interactive dashboard for improved networking and marketing practices. The architecture is made up of a cloud administrator panel, a web-based dashboard for customers, and mobile contactless experiences that let users create richer profiles and have immediate access to the profile's information. This section contains the Software Requirements Specification (SRS) of the proposed system, which covers both functional and non-functional requirements for further development.

3.4.1.1 Functional Requirements

This part encompasses all the essential requirements and functionalities that an NFC business card system should have in order to meet the user's expectations. Among the requirements are providing an uncomplicated place for digital networking, gathering engagement data, and supporting a flexible architecture for managing profiles and conducting strategic analytics.

table format

Table 2-1. Functional requirements for the Developed System

Module	**Description**
User Registration and Login	Allow clients and admins to register and log in securely using email and password. Support role-based authentication.
NFC Scan Handling	Process NFC scans, redirect users to digital profiles, and log scan metadata (e.g., time, location).
Profile Management	Aside from Admin, Clients can update headlines, bios, contact info, and social links through a user-friendly dashboard.
Real-Time Engagement Logging	Record user interactions on the digital profile (e.g., clicks, button taps) for analytics purposes.
Admin Dashboard	Monitor user activity, analyze engagement trends, manage user roles, and configure card behaviors.

Module	Description
Analytics Integration	Generate and visualize metrics like scan counts, top links, user location heatmaps, and time-based trends.
Notification System	Send real-time email or SMS notifications to clients when users engage with key profile elements.
Role-Based Access Control	Ensure that admins, clients, and end users have access only to the modules relevant to their roles.
Cloud Database Management	Store all user data, profile content, engagement records, and system configurations in a secure database.

3.4.1.2 Non-Functional Requirements

The anticipated performance of the system in a diversity of environments, with a stress on usability, scalability, and reliability as the main factors for users' continuous success and satisfaction, has been documented in this section of the report.

Table 2-2. Non-Functional requirements for the Developed system

take format

Module	Description
Portability	The system should function across modern web browsers and mobile devices (Android/iOS) without performance issues.
Scalability	Must support increasing numbers of users, scans, and profile views without degradation in performance.
Reliability	Ensure system uptime and data logging continuity, especially during NFC scans and engagement recording.
Security	Implement secure login, encrypted data transmission (HTTPS), and role-based access restrictions.
Performance Efficiency	Real-time data capture with minimal latency during profile access and analytics processing.
Usability	Interfaces should be intuitive for non-technical users (clients and end users), with easy navigation and clear visuals.

Module	Description
Availability	24/7 availability with fallback mechanisms to handle outages or server errors.
Interoperability	Support integration with third-party tools such as CRM systems, analytics platforms (e.g., Google Analytics), and messaging APIs.

3.4.2 Hardware and Software Requirements

In this section, the minimal hardware and software needed for development, access, and usage of the NFC Business Card System are discussed. The system gives the users (with NFC-enabled devices) a mobile-facing interface, a client-based web dashboard, and an admin control panel for monitoring and analytics of the system. This will lead to the seamless working of NFC technology, dependable performance, and synchronization of data in real-time.

Table 3.1 Hardware Requirements in using the System

User Type	Equipment	Type/Specification
End User (NFC-enabled Device)	Smartphone (iOS/Android)	NFC support, at least 3GB RAM, Quad-Core Processor, and 4G/LTE or higher internet access is required.
Client (Web Dashboard)	Laptop/Desktop	Intel i3 or equivalent, minimum 4GB RAM, HDD/SSD, and internet connectivity (minimum 3 Mbps)
Admin (Web Admin Panel)	Laptop/Desktop	Intel i5 or equivalent, 6GB RAM, SSD or HDD, and stable internet connection (minimum 5 Mbps)

Table 3.2 Software Requirements in Using the System

User Type	Required Software
End Users	- Updated mobile operating system (Android 8.0+ or iOS 13+)

User Type	Required Software
	- Default mobile browser (Chrome, Safari, or equivalent) - NFC-enabled mobile device software
Clients (Web Dashboard Access)	- Web browser (e.g., Google Chrome, Mozilla Firefox, Microsoft Edge) - JavaScript enabled - Internet connection with at least 3 Mbps - Optional: Email client for receiving notifications
Admins (Admin Panel Access)	- Web browser with JavaScript support - Access to admin portal through secure HTTPS connection - Authentication credentials for role-based access

3.4.3 Database Design

This section covers the database setup of the NFC-based business card solution with MongoDB; it is a document-centric NoSQL database. The proposed architecture is meant to be a great fit for the different user engagement scenarios and realistic analytics because it is flexible, scalable, and efficient in terms of data management.

3.4.3.1 NOSQL Database Type

Managing unstructured and evolving data types, like user profiles, NFC tap events, or engagement metrics, is the main reason behind the implementation of a MongoDB document-oriented data storage system. The presence of a predefined schema

is a requirement for those flexible JSON-like documents, in contrast to inflexible relational databases. For content with very dynamic options, like embedded online videos, social media links, or real-time analytics, this flexibility is needed.

3.4.3.2 Conceptual Design

Each separate entity is represented by collections in the system. The foundation collections are:

Table 4. Database Collections and Fields

Collection	Fields
users	_id, full_name, email, password_hash, role (e.g., "user", "admin"), created_at
cards	_id, user_id (references users._id), card_uid, card_name, redirect_url, status (e.g., "active", "inactive"), created_at
events	_id, card_id (references cards._id), event_type (e.g., "tap"), location, ip_address, user_agent, timestamp
engagements	_id, user_id (references users._id), card_id (references cards._id), element_id (e.g., "video", "schedule_button"), action (e.g., "click"), timestamp
profiles	_id, user_id (references users._id), headline, bio, profile_picture, website, created_at
social_links	_id, profile_id (references profiles._id), platform (e.g., "LinkedIn", "GitHub"), url,

Collection	Fields
	icon, created_at
sessions	_id, user_id (references users._id), session_token, expires_at, created_at
activity_logs	_id, action (e.g., "card_created", "profile_updated"), performed_by (references users._id), entity (e.g., "card", "event"), entity_id, timestamp

3.4.4 Trade-off and Multiple Attributes

The design of the innovative business card with an NFC tag is a constant process of change, as it attempts to find the perfect combination of real-time analytics, data security, user-friendliness, and scalability. Sometimes, the enhancement of one aspect leads to the impairment of another. For example, if the priority is given to extremely low latency for NFC communication, then very precise tracking of related data will probably be compromised. Moreover, strong encryption techniques, combining HTTPS and JWT authentication, will render the data exchange very secure but may also result in a minor speed reduction in profile loading. Provide personalized interactions with people and continue to grow, but that growth comes with an equivalent increase in operating costs; moreover, a user-friendly improvement for the dashboard hindered advanced customization. In such deliberate trading, the system here permits professionals like Sarah to exchange notes with one another on interactions that are aimed at knowing

whom to contact in order to optimize networking strategies better, all the while keeping the flexibility and security of long-term systems in mind.

3.5 Development

3.5.1 Software Development Tools

During the entire development process leading to the launch of the NFC-compatible smart business card procedure, software tools and technologies were chosen very meticulously by the project stakeholders with the intention of getting a safe and scalable architecture. The entire system is developed following the full-stack MERN, i.e. MongoDB, Express.js, React, and Node.js paradigm. The development not only ensures a responsive design but also provides real-time analytics. The process of scanning and redirection will be made very easy as soon as the NFC functionality is connected with an NFC module that works with smartphones. The backend will have features like engagement tracking, profile management, and role-based access control incorporated within it.

The setup for development will have Visual Studio Code as the main IDE with version control done through Git and GitHub. Postman will be used for API testing and validation of backend endpoints, whereas MongoDB Atlas will be the provider of the

cloud database. Real-time analytics and event logging will be done using WebSocket protocols and cloud functions.

Table 5. Software Requirements for Developing the NFC Business Card System

User Type	Minimum Requirement
Frontend Development	React.js, Tailwind CSS, Vite, Visual Studio Code
Backend Development	Node.js, Express.js, MongoDB Atlas, WebSocket
API Testing	Postman, Thunder Client
Version Control	Git, GitHub
Analytics & Engagement	WebSocket, MongoDB Aggregation Pipelines

3.5.2 Hardware Development Tools

The NFC business card solution was properly tested and implemented with the following specified tools. It used NFC-enabled smartphones for scanning and interaction testing, while the laptops or desktops were allocated for development and backend operations. The websites or identifiers that direct users to custom profiles controlled through the web dashboard were encoded into NFC tags or cards.

The testing was conducted on Android and iOS devices to ensure the compatibility of the platform. The laptops or desktops with low specifications were sufficient for both frontend and backend development work.

Table 6. Hardware Requirements for Developing the NFC Business Card System

Hardware	Minimum Requirement
NFC Scanning Device	Smartphone with NFC support (Android/iOS)
NFC Tag	NTAG213/NTAG215/NTAG216 or equivalent NFC tags/cards
Development Machine	Intel i3 or higher, 8GB RAM, SSD storage, and stable internet
Test Devices	Multiple Android/iOS smartphones for cross-device compatibility

3.6 Testing and Evaluation

Once the integrations of the backend, frontend, and NFC are complete, testing and evaluation ensure the smooth functioning of each feature through the application of realistic scenarios. The software group performed the installation, the paths for performance and security testing; the card scans, location capture, engagement logging, and dashboard visualization were all simulated; and the admin/cardholder/visitor flows

were checked for reliability and usability. Problems were resolved early, making the system reliable, secure, and user-friendly.

The entire process followed ISO/IEC 25010:2011 and the goals of the project: to produce an NFC-enabled smart business card that saves/transmits digital contact and multimedia info (including meeting requests) in a secure way, to have real-time engagement analytics for scans, location, and interactions, to make a web dashboard for the data visualization and optimization, and to get feedback from the experts and the target users on functionality, usability, reliability, efficiency, security, and compatibility.

3.7 Deployment

3.7.1 Sustainability and Maintenance Plan

The NFC Business Card System Sustainability and Maintenance plan provides coverage of the system's security and the user's uninterrupted performance, along with the client's long-term usability. The deployment strategies of the system are presented and explained within the plan.

Deployment was done in phases after the application of quality assurance testing. A controlled pilot phase granted access to the system for chosen client companies in order to monitor the real-time use of NFC features, link accuracy, and dashboard usability. The opinions of the clients and administrators were taken into account for

further optimization of performance. Afterwards, it was made available to other client participants. This method reduced the risk and problems earlier than before the large-scale implementation.

Training and Turnover

Training and turnover focused on the system's two main user groups, Clients and Admins. Clients were trained on how to manage digital business cards, customize their profiles, get the analytics for NFC tracking, and access engagement data via the cloud-based dashboard. Admins were instructed on how to keep the system running, control user access, manage the database, and ensure compliance with data privacy and security regulations. They were provided with training materials to support their learning process.

The End Users, who only use the NFC cards, did not need formal training since their role was very limited and consisted solely of scanning NFC cards to get access to basic information about the clients, such as profiles, contacts, and company links. During the transition period, documentation related to system design, credentials, operational guides, and maintenance procedures was passed over to the client's IT teams and admin staff to make them self-sufficient.

Maintenance Plan

As for the Maintenance Plan, the developers will be responsible for the NFC tag functionality checks, like software upgrades, and database upkeep, in addition to regular check-ups that will be done to make sure the dashboards are secured, working, and up to date, which will, in turn, not annoy the users and make it a pleasant experience for them. Software updates will solve problems such as silence of the system, misreporting of the data analytics, and bugs in the dashboard. A support channel exclusively for Clients and Admins will be set up to help in case of any issues. Moreover, the system performance will be evaluated using quantitative metrics to make company changes, and that means the NFC Business Card System will not only keep meeting user expectations but also keep improving through time.

CHAPTER IV

RESULTS AND DISCUSSION

This chapter presents the results and conclusions of the project titled "Development of an Intelligent Business Card using NFC with Real-Time Analytics." After that, it carefully explains the methodology used to assess the system's performance, usability, and overall functionality. The findings are then analyzed against the project objectives to determine whether they were met. In addition, the chapter recounts the researchers' emotional and perceptual experiences during the testing phase, along with the challenges and limitations they encountered. Finally, the chapter provides a thorough description of the collected data and discusses how the system can be improved for future development.

4.1 Results by Phase of Study

The research results in this section are presented by stage of system enhancement. The goals tackled, the methods applied, and the results obtained are all documented at each phase of development and testing. It illustrates the entire procedure for the system's feature development coherently, enabling the objectives to be successfully met.

NFC Business Card and User Profile

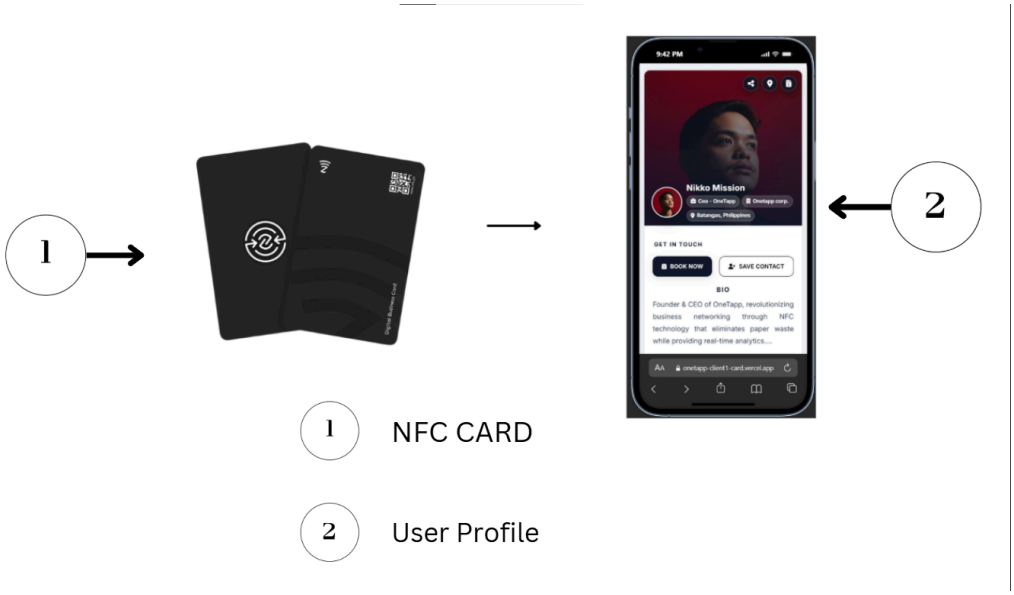

Figure 14: NFC Card with User Profile

The utilization of NFC cards for business networking is illustrated in Figure 14. The NFC card (1) serves as a physical digital business card. When placed close to an NFC-enabled smartphone, the user profile (2) will appear on the receiver's mobile device. The user profile gives the receiver access to contact information and company details, and it also allows saving the contact or booking a meeting, making the information transfer easy and paperless. Therefore, the entire process requires an NFC-enabled smartphone for the interaction to take place.

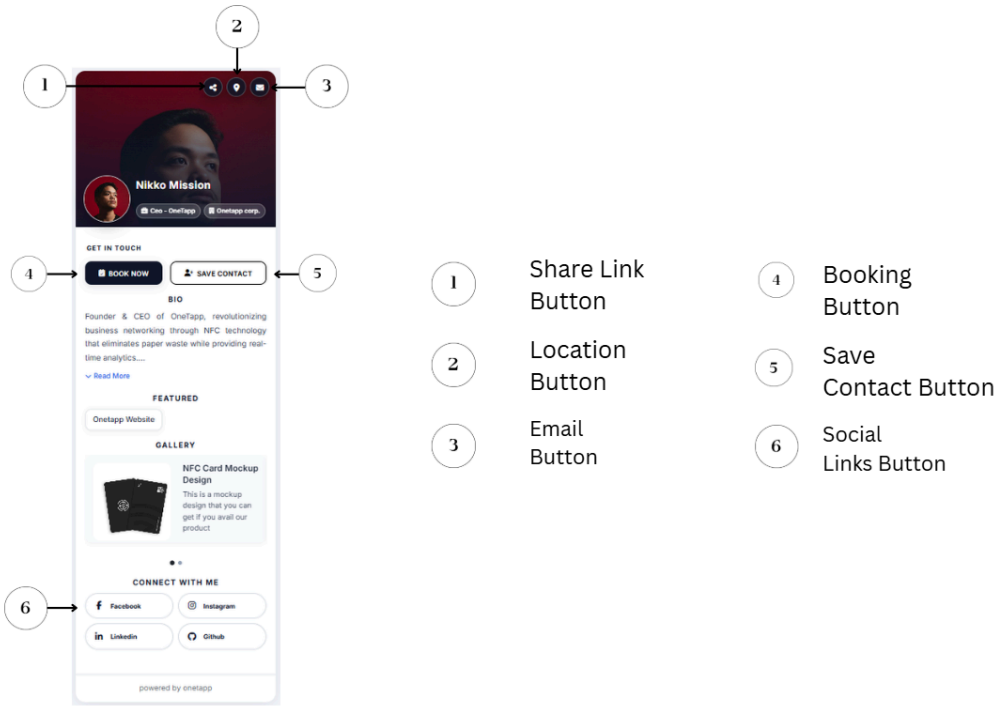

Figure 15: User Profile

The interface is shown in Figure 15 as a digital profile or contact card, which is aimed at facilitating connections and appointments. The users can distribute their card's link using the Share Link Button (1), find out the person's position through the Location Button (2), and reach them instantly via the Email Button (3). The interface contains outstanding controls for reserving appointments with the Booking Button (4) and for holding the contact details with the Save Contact Button (5). At last, the Social Links Button (6) lets users go through the person's social media accounts rapidly. This

arrangement gives a complete, easy-to-use layout for the management of personal branding, reservations, and direct communication.

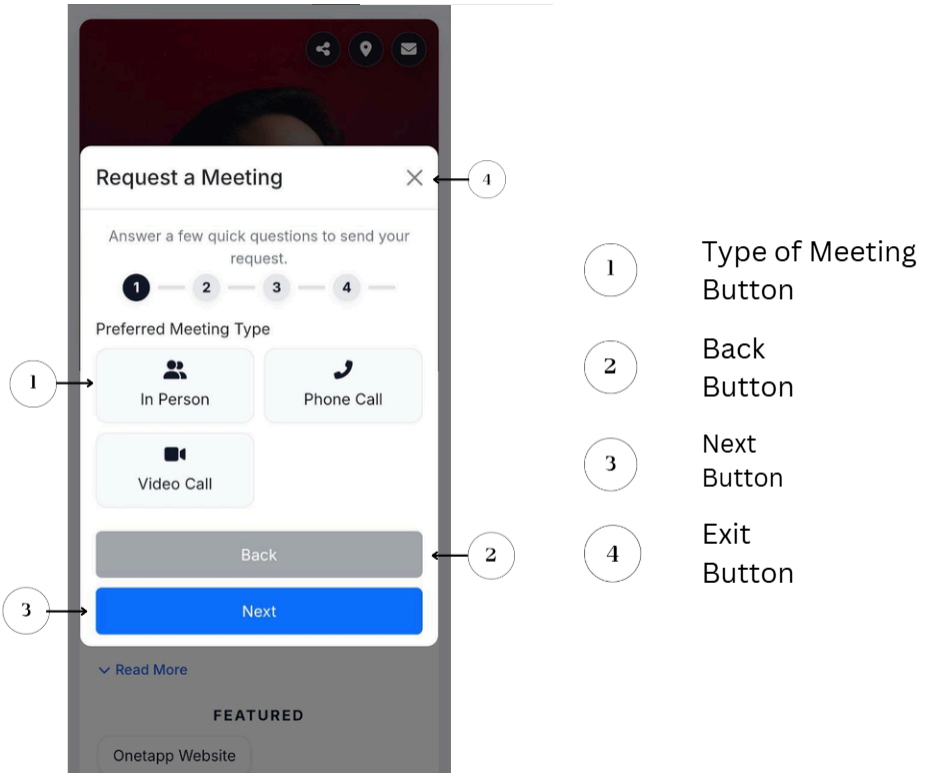

Figure 16: Request Meeting

The meeting request interface, illustrated in Figure 16, helps a user in a step-by-step manner to schedule a meeting. The first step for users is to pick the type of meeting they prefer - either In Person, Phone Call, or Video Call - using the Type of Meeting Button (1). The Back Button (2) allows going back to any of the preceding steps, while the Next Button (3) assists in advancing through the stages. If the users decide to quit the request at any particular moment, they can press the Exit Button (4). The whole

arrangement provides a very straightforward and user-friendly procedure for arranging various kinds of meetings with just a few clicks.

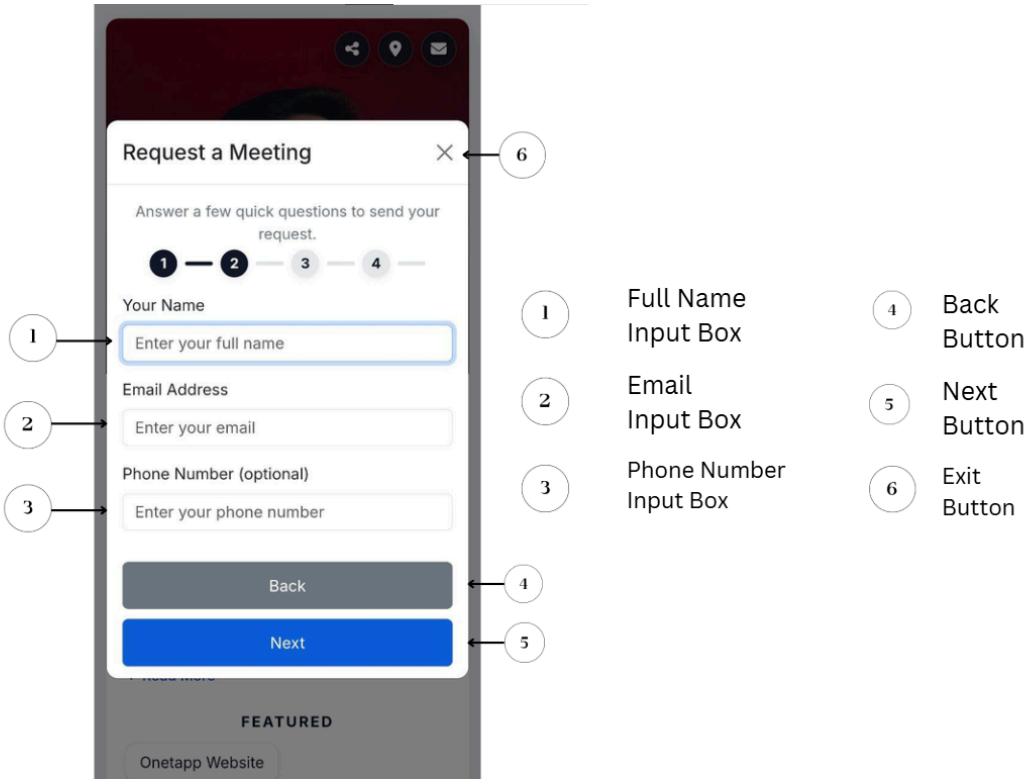

Figure 17: Request Meeting

Figure 17 continues the "Request a Meeting" workflow, where users enter their contact details to finalize the meeting request. The system asks users to fill in their complete name in the Full Name Input Box (1), their email address in the Email Input Box (2), and their phone number in the Phone Number Input Box (3) as a choice. The

Back Button (4) takes you back to previous steps, and the Next Button (5) allows you to go ahead and control the movement through the form. The Exit Button (6) is always there for the users to click and end the process at any stage. This systematic data input process guarantees that all the necessary contact information is quickly gathered while the meeting is being set up.

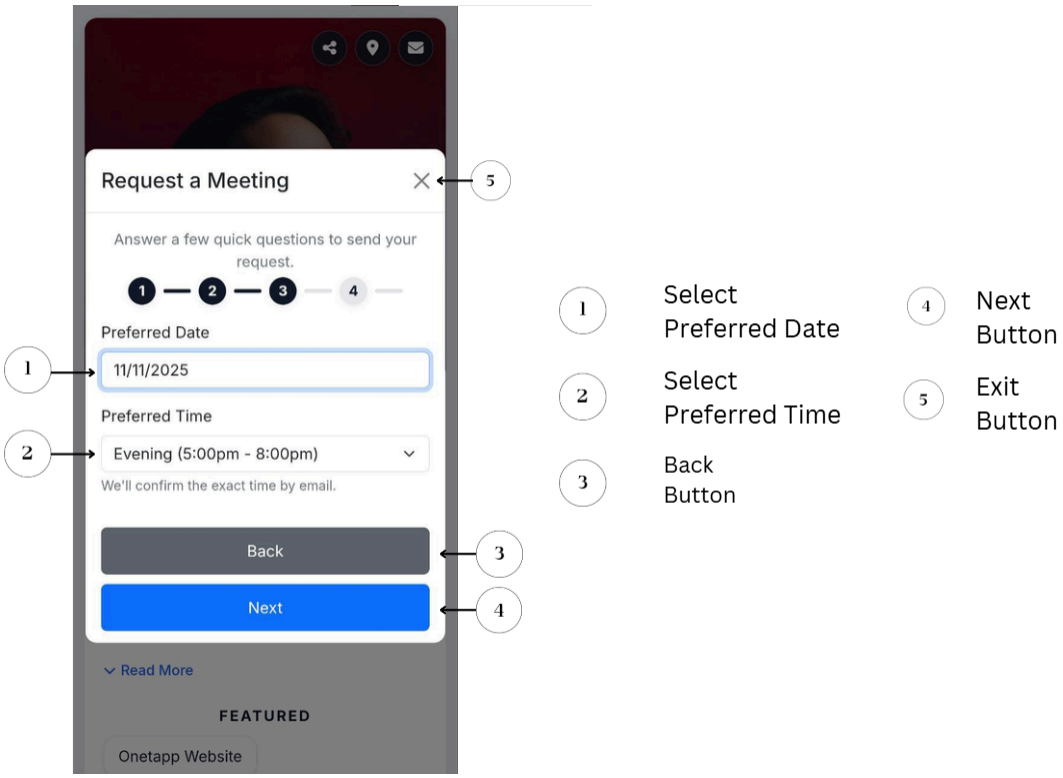

Figure 18: Request Meeting

The "Request a Meeting" process is extended in Figure 18 with the option for users to state their scheduling preferences. The Select Preferred Date input box (1) is used by the users to indicate their most suitable meeting date, while the Select Preferred

Time dropdown (2) is used to pick a time slot. The Back Button (3) is for navigating back to earlier stages, and the Next Button (4) is for proceeding. The Exit Button (5) allows users to leave the scheduling process whenever they want. This phase guarantees that the meeting is arranged at a comfortable time for both and, at the same time, the efficient, user-friendly flow of the meeting request sequence is maintained.

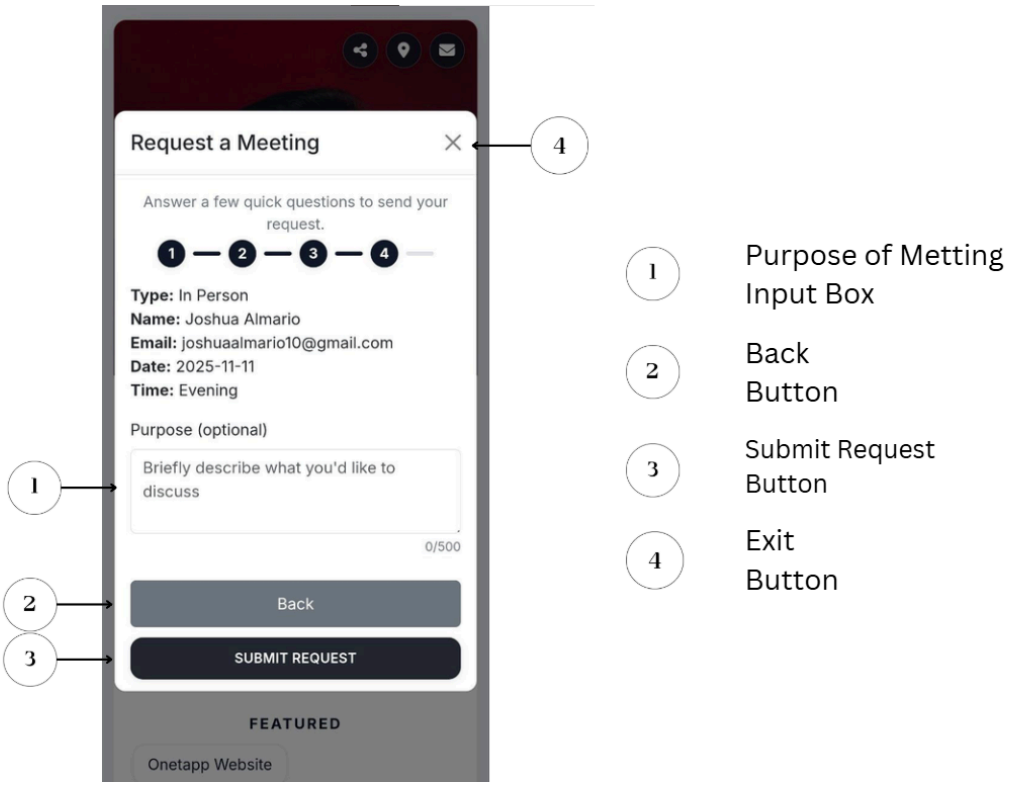

Figure 19: Request Meeting

The final step of the "Request a Meeting" procedure is shown in Figure 19, which is the point at which users confirm and submit their meeting details. All the information

the user has chosen regarding the meeting type, the user's name, the user's email, the date, and the time is given in a summary for the user's consent. User can also provide in the Purpose of Meeting Input Box (1) their opinion on the matter, by optionally filling it in. The Back Button (2) allows navigation to previous answers for making changes, and the Submit Request Button (3) enables users to finish and send their meeting request. An Exit Button (4) is available if you want to leave the process anytime. This step guarantees that all details are verified before the meeting request is sent out officially.

Booking Management

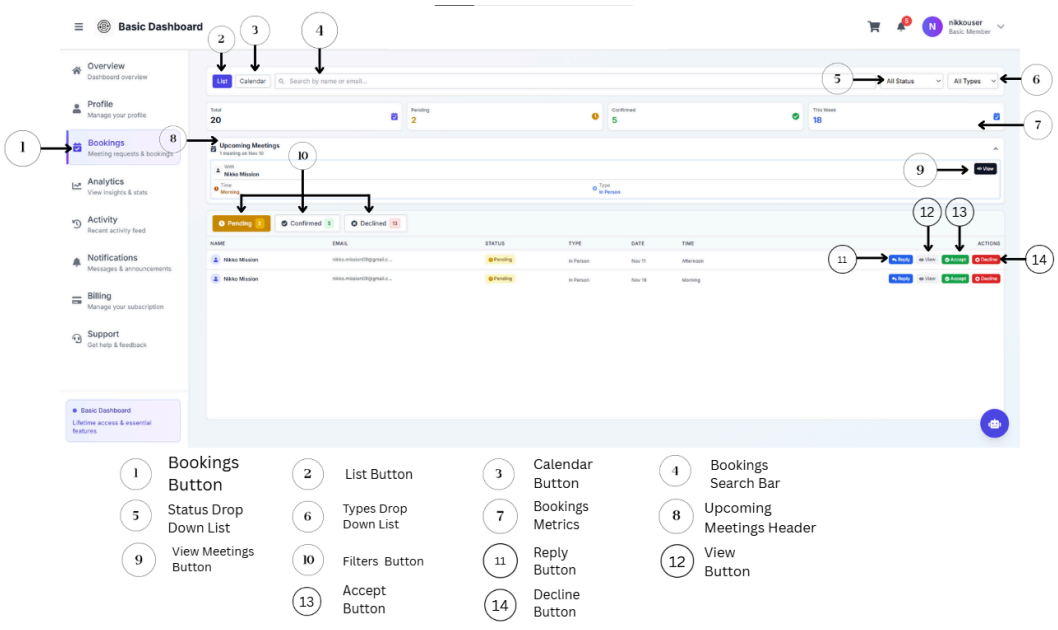

Figure 20: Bookings Dashboard

The Bookings Dashboard, depicted in Figure 20, is the main user interface for controlling meeting requests. The users can access the bookings through the Bookings Button (1), can toggle between the list and the calendar views using the List Button (2) and Calendar Button (3), and can look for the meetings with the help of the Bookings Search Bar (4). Status (5) and Types (6) filters make it easier to sort the appointments, and at the same time, Bookings Metrics (7) provide a summary of the whole activity. Under the Upcoming Meetings Header (8), the next meetings are enumerated, and for detailed information, one must click the View Meetings Button (9). Filters (10) plus action buttons to Reply (11), View (12), Accept (13), or Decline (14) each request, make it possible to handle appointments promptly and efficiently from one and the same dashboard.

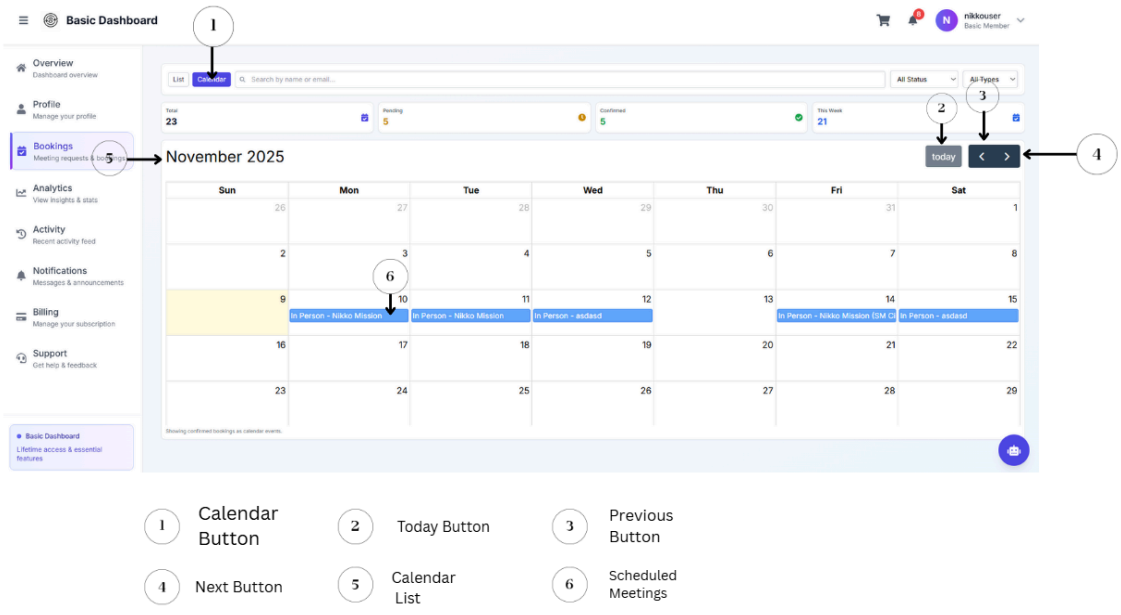

Figure 21: Bookings dashboard

Figure 21 is a follow-up that illustrates the calendar view of the Bookings Dashboard users. The Calendar Button (1) allows users to switch to the calendar format, the Today Button (2) takes them to today's date, and the Previous (3) and Next (4) Buttons enable them to move between months. The Calendar List (5) shows all days of the month, during which Scheduled Meetings (6) are represented as events, thus aiding users in viewing and managing their meetings in a clear and chronological layout.

Real-time engagement analytics and Web-based Dashboard

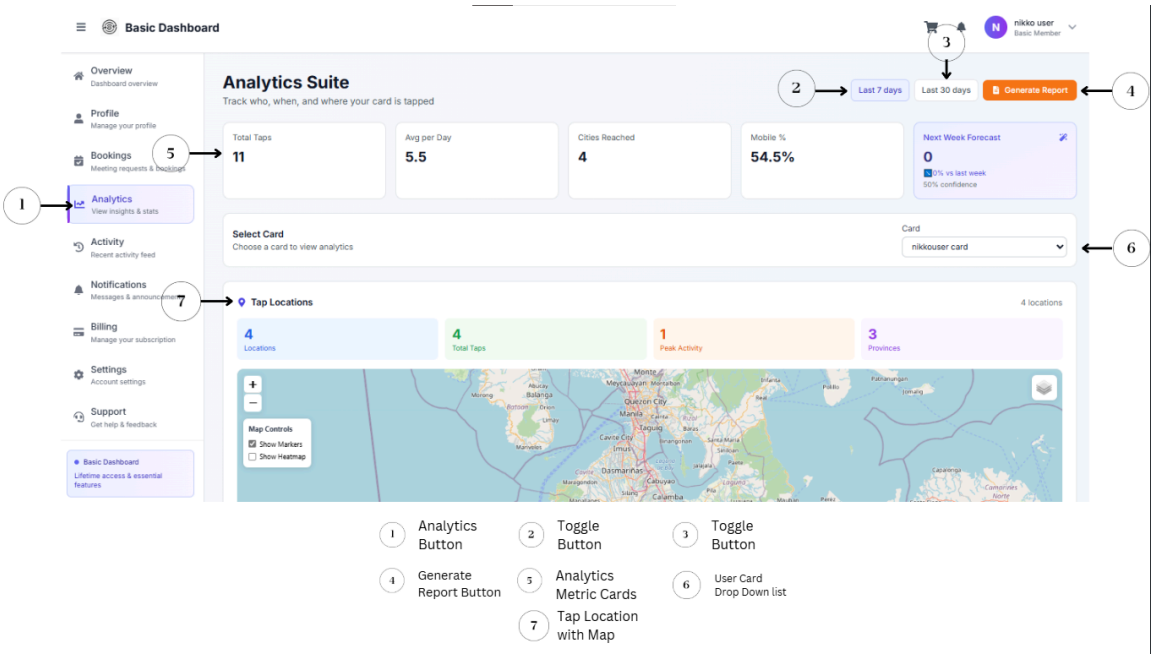

Figure 22: Analytics Dashboard

The Analytics Suite Dashboard is depicted in Figure 22; it serves as a means to monitor the activity of NFC card interactions. The users can view the analytics by using the sidebar (1) and can change the data displayed by selecting the different time periods (2, 3). Users can also make a report in detail and download it (4), and the dashboard shows the main measurements such as total taps, cities reached, and mobile usage (5). The users can pick the NFC card that they want to analyze (6), and they can also see an interactive map (7) that indicates the exact location where their card was tapped. This configuration provides the users with a manageable and clear-cut NFC card engagement and location trends overview.

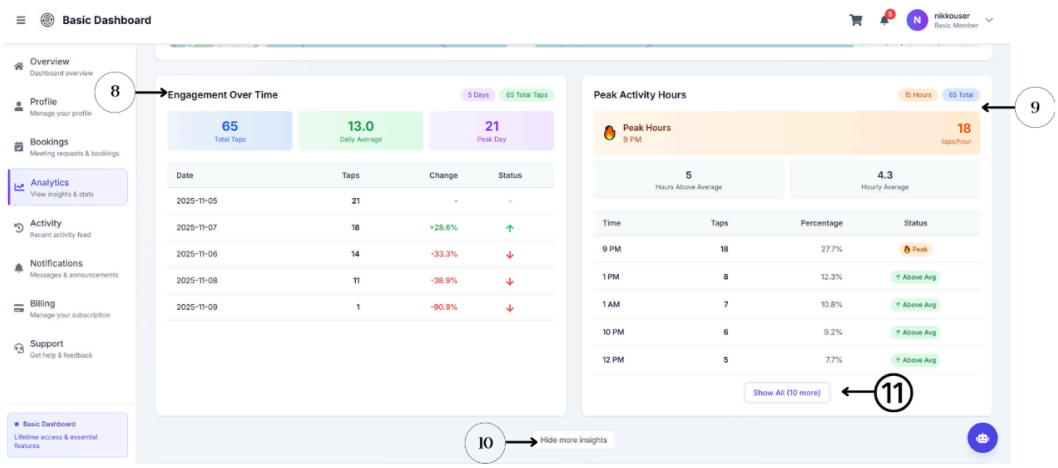

Figure 23: Analytics Dashboard

The Analytics Dashboard, which is shown in Figure 23, adds two crucial components. The Engagement Overtime Graph (8) is constantly updated as a point graph with the number of taps done on cards, the number of unique users, and trends during a specified period, which is the whole purpose of this people card monitoring; thus, users will be able to tell how and when their card was used. The Peak Activity Hours Graph (9) points out the most active times for card activities, enabling users to locate the moments of the highest interaction. Users can personalize their dashboard view by either hiding unnecessary insights using the Hide More Insights Button (10) or displaying all detailed metrics through the Show All Button (11). When the aforementioned functionalities are taken together, they contribute to engagement pattern monitoring and more effective management of NFC card networking strategies by users.

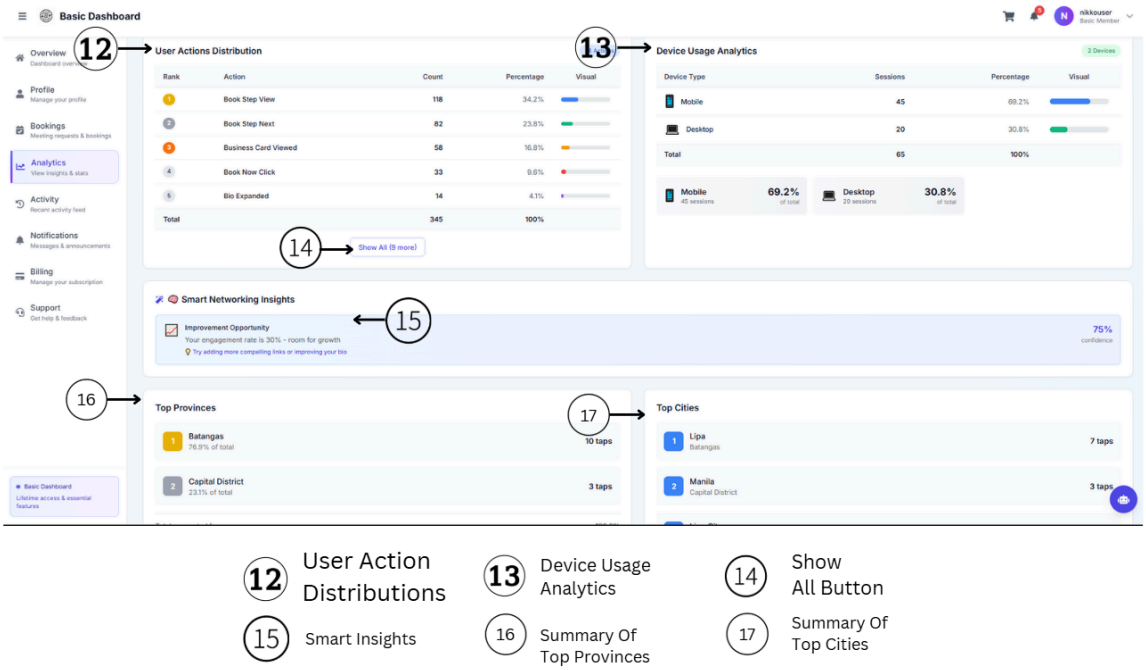

Figure 24: Analytics Dashboard

In a condensed representation, Figure 24 portrays user engagement and device analytics, thus giving a summary of extra analytics features. User Action Distributions (12) illustrate the frequency of particular interactions, whereas Device Usage Analytics (13) depicts the composition of mobile and desktop sessions. Clicking on the Show All Button (14) opens up more data to the user. Smart Insights (15) in a flash gives advice and suggests the contacts to connect. The location-oriented overviews of Top Provinces (16) and Top Cities (17) highlight the regions where the most NFC transactions are happening.

Functional Test Results by User Role

The testing of the Admin, User, and NFC Card Tappers user roles was executed in accordance with their specific responsibilities, with the aim of confirming that the system actually performs its intended functions properly and reliably. A comprehensive evaluation yielded a consistent score of 100% Passed across all roles, thus confirming that the system is entirely functional, reliable, and ready for deployment. The details of the successful outcomes of each user type are presented in the following subsections.

Admin Role

The functional testing of the Admin role successfully cleared the entire set of eight main test cases, demonstratingd the role's exceptional performance. This indicates that the system is entirely functionally sound as far as high-level administration, which includes access to detailed business reports and predictive analytics, user and NFC card management, database backup and restore, and also security features like account self-management, is concerned. The Admin role did an outstanding job in test driving – all tasks were carried out smoothly without any issues. The team managed to do everything great: user accounts and profiles management, NFC card assignments and activation, order processing and subscription management, and reporting on analytics and revenue metrics across the platform. In addition, the Admin can always check analytics and forecasts and keep the activity logbook very up to date. It all simply proves that the system is robust and able to withstand the daily mistreatment of operation behind the

scenes. The perfect score evidences complete compliance with all administrative requirements.

User Role

The User feature achieved a complete pass rate of 100% with the seven use-cases that were tested to be functionally correct of the front-line components. The Basic Users were able to perform the basic operations for managing their NFC card profiles, such as attendance and booking requests, access to real-time viewing of engagement analytics and tap data, geographic distribution insights, device analytics, social link click tracking, and billing management. These results positively reinforce the capability of the system to manage vital profile management and analytics interfaces at the core of Basic Users' duties effectively.

NFC Card Tappers (End Users/Visitors)

The NFC Card Tappers (Public Website) testing was done with an perfect score of 100% success across all ten test cases that are accessible to the public. This confirms the whole user experience that is external and includes the availability of business cards and contact information through NFC tap or web link, making requests to book a meeting, giving out contact info, saving contacts on their devices, and using premium features like social media link integration, gallery viewing, featured links access, location-based directions, and card sharing. The repeated positive outcomes prove that the system is

fully ready for public use and that it has met all the functional requirements for external use.

Summary of Functional Test Results

After that, the functional testing phase took place, which tested every feature of the system thoroughly under the three different user roles: Admin, Basic User, and NFC Card Tappers. It was a decisive test that proved the system could operate flawlessly and was ready to be released. For the three user types, thirty-two separate test cases were planned and executed. These cases varied in their focus from the top-level maintenance and security of the system to the core operational workflows and interactions with the public. Among all the attempts made, the answer was “Successful” for every case, and hence the total percentage of passes for all functional requirements was 100%. Such a performance level is a clear indicator that the developed system is in line with and meets the letter and spirit of all the functional requirements of the project as initially stated, which in turn confirms the robustness of the underlying architecture and the reliability of the application to perform its functions without any defects or failures across all access levels.

The total functional testing of the system on all three user profiles has validated that the system is operationally and deployment-ready, as all requirements received full credit. This validation of the system's architecture also guarantees that all functions will be executed smoothly without any bugs.

So far, the formal search has gone well in all formal tests. But when the 'live bringing up' has been attempted, something goes wrong regarding the system, with difficulties. These issues were of a minor nature and were thus very quickly resolved. When the application was used for operational purposes for the first time by the Admin role, some inconsistencies were temporarily reported on both the analytics dashboard and the forecasting displays. The data was quickly corrected to ensure that it was displayed correctly and accurately in both the link and visualization settings. Very minor ones noticed by the user interface, such as slight misalignment of elements and a very short delay, were repaired right away. The system's adherence to 100% functional compliance in spite of these minor changes and within an incredibly short time frame attests to the robustness of this system and the capability of the project team to tackle incidents. The above-mentioned improvements, which were made after testing, guarantee a consistent and completely compliant user experience for the final deployed system.

4.2 Results and Evaluation using ISO/IEC 25010:2011 Standards

The system was evaluated by two groups: experts and users. All groups ranked the system according to important criteria such as Usability, Functionality, Reliability, Efficiency, Security, and Overall Satisfaction. The purpose of these evaluations was to find out if the system achieved its goals and was ready to be used.

Expert Evaluation

Three experts performed an evaluation of the system using a four-point Likert scale, with scores ranging from "1 (Strongly Disagree)" to "4 (Strongly Agree)." The 29 evaluation questions were allocated to six groups: Usability, Functionality, Reliability, Efficiency, Security, and Overall Satisfaction. Once the researchers showed the system, the experts took the survey. The report on the performance in each category is presented below.

Table 7. Summary of Evaluation in terms of Usability

Statement	Weighted Mean	Verbal Interpretation
1. The admin and user dashboards are intuitive and easy to navigate.	3.33	Agree
2. The forms for creating or updating business cards and profiles are clearly labeled and easy to complete.	3.67	Strongly Agree
3. The map and analytics features (e.g., zoom, filter, export) are easy to understand and use.	3.67	Strongly Agree
4. The system feedback (such as toast messages, modals, or error alerts) clearly guides the user on any required next steps,	3.67	Strongly Agree
Composite Mean:	3.58	Strongly Agree

Table 7 summarizes the evaluation by experts and the results obtained in the usability dimensions. Overall, the system received a very high rating, with most of the items receiving a score of WM = 3.58. The interface was user-friendly and pretty enjoyable to work with. Moreover, the setting of the dashboard was praised for being easy to understand and tidy, which allowed for reports and notifications to be available easily and together to make the interaction with the system icy smooth. The observed major drawback was the lower score on dashboard intuitiveness (WM = 3.33), which shows that navigation and first-time clarity need more polishing.

Table 8. Summary of Evaluation in terms of Functionality

Statement	Weighted Mean	Verbal Interpretation
1. The card and profile management features include all required fields and actions, functioning correctly from start to finish.	4.00	Strongly Agree
2. The sharing events (tap logs) and analytics data are correctly recorded and integrated with the backend.	4.00	Strongly Agree
3. The subscription management and checkout processes correctly handle plan changes and generate appropriate receipts.	3.67	Strongly Agree

4. The notifications, announcements, and messaging features behave as intended.	4.00	Strongly Agree
5. The export, reporting, and backup features produce accurate and complete outputs.	3.67	Strongly Agree
Composite Mean:	3.86	Strongly Agree

Functionality, with a composite WM of 3.86 (Strongly Agree), is depicted in Table 8. The highest items were card/profile management, tap-log/analytics integration, and notifications/messaging (all 4.00). Subscription/checkout handling and export/report/backup accuracy were the only weaknesses at 3.67, suggesting that slight improvements are required in these areas.

Table 9. Summary of Evaluation in terms of Reliability

Statement	Weighted Mean	Verbal Interpretation
1. The common user workflows complete without crashes or blocking errors.	3.67	Strongly Agree
2. The user data persists correctly across sessions and page refreshes.	3.67	Strongly Agree
3. The file uploads succeed reliably for all supported file types and sizes.	4.00	Strongly Agree

4. The system handles network failures gracefully (e.g., provides clear retry instructions).	4.00	Strongly Agree
5. The system logs and audit trails consistently record key user and system actions.	4.00	Strongly Agree
Composite Mean:	3.86	Strongly Agree

Functionality was one of the aspects that the Evaluation and Results for Experts in Table 9 highlighted. The system received the highest rating (WM = 3.86) in all aspects, and the specialists unanimously thought that it was aligned with the project objectives due to excellent module intercommunication. The only thing that stood out was the somewhat low scores (WM = 3.67) for subscription/checkout management and for export/report/backup precision, showing that those parts only require little improvements to become equal with the others.

Table 10. Summary of Evaluation in terms of Efficiency

Statement	**Weighted Mean**	**Verbal Interpretation**
1. The tasks (e.g., creating cards, updating profiles, running reports) complete within an acceptable time.	4.00	Strongly Agree

2. The system response remains acceptable even with larger datasets (e.g., many users, taps, or orders).	4.00	Strongly Agree
3. The search, filtering, and pagination features allow finding information with minimal effort.	3.67	Strongly Agree
4. The typical user tasks execute quickly with minimal delays.	4.00	Strongly Agree
5. The system significantly improves speed compared to equivalent manual processes.	4.00	Strongly Agree
Composite Mean:	3.93	Strongly Agree

According to Table 10, the experts rated reliability highly (composite WM = 3.86), with backup and recovery listed as the major strengths among others. In the Efficiency section, the items mostly got a 4.00 score, except search/filter/pagination, which got a 3.67 score, showing that there is still a little room to make the process of finding information faster. Thus, the overall efficiency still remained very high (composite WM = 3.93).

Table 11. Summary of Evaluation in terms of Security

Statement	Weighted Mean	Verbal Interpretation
1. The authentication and authorization correctly enforce access privileges for each user role.	4.00	Strongly Agree
2. The input validation and rate limiting mechanisms protect the system against common abuses (e.g., invalid requests or excessive usage).	3.67	Strongly Agree
3. Sensitive information (e.g., API tokens or secrets) is not exposed to clients or logs.	4.00	Strongly Agree
4. The file upload feature enforces allowed file types and size limits, and uploaded files are stored securely with proper access controls.	4.00	Strongly Agree
5. The payment webhooks and subscription update processes are implemented securely and handle repeated requests idempotently.	4.00	Strongly Agree
Composite Mean:	3.93	Strongly Agree

Table 11 shows the Evaluation and Results for Experts in Efficiency. The system has a composite WM of 3.93, with the experts' consensus that it is fast, accurate, and delivers the right number of steps. The one weakness pointed out was that the trio of

search/filter/pagination was rated a little lower (3.67), which suggests a slight chance to speed up the information locating process.

Table 12. Overall Satisfaction Summary of Evaluation

Statement	Weighted Mean	Verbal Interpretation
1. The system effectively meets its stated project objectives.	4.00	Strongly Agree
2. The solution appears production-ready and suitable for the intended users.	4.00	Strongly Agree
3. The benefits of the solution are clear to both administrators and end-users.	4.00	Strongly Agree
4. The solution could be deployed after only minor refinements.	4.00	Strongly Agree
5. The overall system quality and maintainability are satisfactory.	4.00	Strongly Agree
Composite Mean:	4.00	Strongly Agree

The Overall Satisfaction Summary of Evaluation and Results for Experts has been shown in Table 12. The system received a maximum score (WM = 4.00) in every specification of this aspect. The experts were extremely satisfied with the design,

housing, and execution of the system and reached the same conclusion that the system is well-targeted and has good penetration in the market, being a colleague-friendly solution.

User Evaluation

A panel of ten users evaluated the system. They took part in a survey with thirty-six questions where they indicated their responses using a four-point Likert scale (1 = Strongly Disagree, 4 = Strongly Agree). The questions were divided into six categories: Usability, Functionality, Reliability, Efficiency & Security, and Compatibility & Interoperability. After using the system, the users filled out the survey, and the researchers helped them through the evaluation process. A summary of the results for each category is provided below.

Table 13. Summary of Evaluation in terms of Usability

Statement	Weighted Mean	Verbal Interpretation
1. The interface is easy to understand on first use.	4.00	Strongly Agree
2. Terms, icons, and labels are clear and consistent.	4.00	Strongly Agree
3. I can find important actions quickly (share, edit profile).	4.00	Strongly Agree

4. Error messages tell me how to fix issues.	4.00	Strongly Agree
5. The process of tapping and exchanging business card information using NFC feels straightforward and intuitive.	4.00	Strongly Agree
Composite Mean:	4.00	Strongly Agree

You can find the Summary of Evaluation and Results for Users regarding Usability in Table 13. The system won the complete WM of 4.00, whereby users gave very good ratings for navigation, interface, responsiveness, and design.

Table 14. Summary of Evaluation in terms of Functionality

Statement	Weighted Mean	Verbal Interpretation
1. I can set up my card/profile without help.	3.90	Strongly Agree
2. Tapping/sharing works reliably across phones/NFC readers.	4.00	Strongly Agree
3. Analytics (tap counts/visits) look correct for my activity.	3.90	Strongly Agree
4. Orders/subscriptions work as described.	3.80	Strongly Agree

5. All features work as expected without issues.	4.00	Strongly Agree
6. The NFC feature consistently transfers my contact information without errors or delays.	4.00	Strongly Agree
Composite Mean:	3.93	Strongly Agree

As indicated by Table 14 (Functionality, users), the composite weighted mean (WM) of 3.93 has been assigned the highest rating of 'Strongly Agree'. The areas of the strongest consensus at 4.00 were, namely, tap/share reliability, overall feature correctness, and NFC transfer consistency. Orders and subscriptions working as described received the lowest score of 3.80, while setup without help and analytics correctness both scored 3.90—implying that there is only a slight area where it is possible to make setup easier, order/plan flows be explained in a very clear way, and keep users aware of the accuracy of analytics.

Table 15. Summary of Evaluation in terms of Reliability

Statement	**Weighted Mean**	**Verbal Interpretation**
1. No crashes or freezes during normal use.	3.80	Strongly Agree

2. My NFC business card worked reliably during each use without interruptions or failed transfers.	4.00	Strongly Agree
3. The system is available when I need it.	3.90	Strongly Agree
4. I can retry or recover from failures without losing work.	3.90	Strongly Agree
5. Results (analytics/taps) are consistent across sessions/devices.	4.00	Strongly Agree
Composite Mean:	3.92	Strongly Agree

A composite WM of 3.92 (Strongly Agree) is displayed in Table 15 (Reliability, users). The strengths at 4.00 were the trustworthy NFC transfers and session/device consistent results. The weak point was the “no crashes/freezes” factor rated at 3.80, together with availability and recovery rated at 3.90; thus, stability, uptime, and smoother retry paths are the little areas to be tightened.

Table 16. Summary of Evaluation in terms of Efficiency

Statement	**Weighted Mean**	**Verbal Interpretation**

1. Screens load quickly (dashboard, analytics, profile).	4.00	Strongly Agree
2. Actions respond promptly (save, share, tap logging).	4.00	Strongly Agree
3. Reports/analytics refresh in acceptable time.	4.00	Strongly Agree
4. The system does not slow down my device.	4.00	Strongly Agree
5. Works acceptable on mobile data (LTE/5G).	4.00	Strongly Agree
6. Using NFC to share my business card saves time compared to other methods.	4.00	Strongly Agree
Composite Mean:	4.00	Strongly Agree

The Summary of Evaluation and Results for Users in the Efficiency category is shown in Table 16. The highest WM score of 4.00 was achieved in this category. The users were very much supportive of the opinion that the system was very fast and very smooth, thereby enabling them to complete their activities like booking, sharing information, and saving contact details without any difficulty.

Table 17. Summary of Evaluation in terms of Security

Statement	Weighted Mean	Verbal Interpretation
1. Login and sessions feel secure (e.g., timeouts, re-auth).	4.00	Strongly Agree
2. Only authorized users can access my data.	4.00	Strongly Agree
3. Sensitive fields (contact/payment-related) appear protected.	4.00	Strongly Agree
4. I understand how my data is used/stored (privacy).	4.00	Strongly Agree
5. I trust OneTapp to handle my information responsibly.	4.00	Strongly Agree
Composite Mean:	4.00	Strongly Agree

The Summary of Evaluation and Results for Users regarding Security is displayed in Table 17. This category attained a sound WM of 4.00. Users showed trust in the system to protect their private and business data.

Table 18. Summary of Evaluation in terms of Compatibility & Interoperability

Statement	Weighted Mean	Verbal Interpretation

1. It works well on my device and browser/app version.	3.90	Strongly Agree
2. Sharing works across iOS and Android devices.	4.00	Strongly Agree
3. Exports (CSV) open correctly in Excel/Google Sheets.	3.90	Strongly Agree
4. Links/pages render correctly on social/messaging apps.	4.00	Strongly Agree
5. NFC tap works with typical phone cases/accessories.	4.00	Strongly Agree
Composite Mean:	3.96	Strongly Agree

A composite weighted mean of 3.96 (Strongly Agree) is presented in Table 18 (Compatibility & Interoperability, users). The strengths were among the sharing feature across devices (iOS/Android), link rendering, and NFC with cases (all 4.00). Relative weaknesses appeared in device/browser fit and opening of CSV export with 3.90—these are to be verified across more environments and spreadsheet tools as minor. The very high overall satisfaction was their common impression.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

One of the solutions the researchers proposed was the creation of an intelligent business card that could track user engagement in real time via Near Field Communication (NFC). This chapter presents a synopsis of the primary discoveries, conclusions, and recommendations that were made during the course of the project. The envisioned system is to improve the process of sharing personal details, shed light on engagement, and enable analysts to offer tips for refining networking strategies through the use of safe, novel technologies.

Summary of Findings

NFC technology and real-time engagement analytics were incorporated into a smart web-based Business Card System to improve networking efficiency and enable data-driven decision-making for both individuals and companies. The system takes over the process of sharing contact details, offers safe, instant sharing of virtual business cards, and captures real-time analytics of interactions and engagement, providing users with practical insights. The findings report is organized according to the four main goals, which are:

1. A smart business card system equipped with NFC technology was developed and proved successful. The platform secures the storage of contact information,

multimedia resources, and other business data, and transmits them via NFC technology to ensure user safety and convenience.

2. The integration of a real-time engagement analytics subsystem was completed, and it could monitor user activities such as card scans, geolocations, and various engagement metrics. By having these functions available, companies and individuals can gain insights into the patterns and locations of their networking connections.
3. The project concluded with the installation of a dashboard for online analytics. The dashboard allows users to visualize tracked data and provides support for timely, data-driven feedback during monitoring, analysis, and optimization of their network; hence, their interactions with customers and the market are enhanced. A web-based dashboard enables analytics to be accessed from any device with a browser, thereby bringing together network insights and enabling quick reactions to performance trends.

Conclusion

Based on the established objectives, the following conclusions were reached:

1. The development of the NFC-enabled smart business card system has been a success and indicates that secure, contactless, richly detailed digital profiles can

easily replace traditional paper cards, offering the added advantages of convenience, privacy, and efficiency in the professional networking sphere.

2. The incorporation of a real-time engagement analytics subsystem indicates that networking activities can be quantified and comprehended, thereby allowing professionals and organizations to pinpoint and even modify their outreach strategies according to actual user behavior by knowing the time, place, and manner of interactions.
3. The web-based analytics dashboard has been implemented. It is observed that by bringing together all the data and visual insights in an online interface that is easily accessible, users are empowered to keep track of their performance continuously, to respond to the trends very quickly, and to make decisions that are informed by data and are aimed at getting the best results from their networking.

Recommendations

To ensure continued success and improvement of the system, the following recommendations are offered:

1. Constantly upgrade the web dashboard interface for better user experience and provide comprehensive user support and training to ensure maximum system adoption and effective use.
2. Include more multimedia widgets and further optimize interaction options for greater engagement.

3. Expand the analytics capabilities to include more specific measurements, such as user dwell time, interaction repeat frequency, and detailed engagement breakdowns.
4. Implement strict security measures, securing sensitive contact and treatment data by employing enhanced encryption methods and a two-factor authentication process.
5. Regular assessments should be carried out using user feedback and real-world performance data as the primary basis for decision-making regarding continuous improvements and future expansions.

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APPENDICES

A. RELEVANT SOURCE CODE

B. EVALUATION TOOL

C. USERS MANUAL

D. GRAMMARIAN'S CERTIFICATION

E. TURNITIN RESULTS

F. PROOF OF SYSTEM EVALUATION

G. CURRICULUM VITAE

A. RELEVANT SOURCE CODE

NFC Business Card System - Source Code by Objectives.

1. NFC-Enabled Intelligent Business Card: Secure Storage and Transmission

1.1 Card Data Retrieval and Storage

Backend: Card Profile Retrieval by UID

File:
`backend/controllers/cardController.js`

```javascript
const getCardUserProfileByUid = asyncHandler(async (req, res) => {
    const card = await Card.findOne({ cardUid: req.params.cardUid });

    if (!card) {
        res.status(404);
        throw new Error('Card not found');
    }

    // Check if card is disabled
    if (card.status === 'disabled') {
        res.status(403);
        throw new Error('This card is currently disabled and unavailable to view');
```

```
    }

        const user = await
User.findById(card.userId).select('-pa
ssword');
if (!user) {
    res.status(404);
        throw new Error('User not
found');
    }
    let profile = null;
    if (card.defaultProfileId) {
                profile = await
Profile.findById(card.defaultProfileId
);
    } else {
        // Try to find a profile for the
user
    profile = await Profile.findOne({
userId: user._id });
    }
    // Process profile image and gallery
items
    if (profile) {

ensureProfileImageFormat(profile);

    // Process gallery items to ensure
proper format
            if (profile.gallery &&
Array.isArray(profile.gallery)) {
```

```
                profile.gallery = profile.gallery.map(item => {
                    // Process Cloudinary media items (images/videos)
                    if (item.publicId && item.secureUrl) {
                        let itemType = item.type || 'image';
                        if (item.secureUrl.includes('/video/') || item.duration) {
                            itemType = 'video';
                        }
                        return {
                            ...item,
                            url: item.url || item.secureUrl,
                            type: itemType
                        };
                    }
                    return item;
                });
            }
        }

        res.status(200).json({
            success: true,
            card,
            user,
```

```
    profile
  });
});
```

Frontend: Card Data Fetching

File: `nfc-card-react/src/App.js`

```javascript
// Fetch card data from backend
const fetchCardData = async (cardUid) => {
  const API_BASE = process.env.REACT_APP_API_BASE || 'https://onetapp-backend-website.onrender.com';
  const res = await fetch(`${API_BASE}/api/cards/dynamic/${cardUid}`);
  if (!res.ok) {
    const errorData = await res.json().catch(() => ({ message: 'Card not found' }));
    throw new Error(errorData.message || 'Card not found');
  }
  return await res.json();
};
```

1.2 Contact Information Transmission via vCard

Backend: Public vCard Generation

File:
`backend/controllers/profileController.js`

```javascript
exports.getPublicVCard = async (req, res) => {
  try {
    const { id } = req.params;
    const profile = await Profile.findById(id).lean();
    if (!profile) {
      return res.status(404).send('Profile not found');
    }
    const visibility = profile.visibilitySettings || {};
    const isFieldVisible = (key) => visibility[key] !== false;

    const vCard = [];
    vCard.push('BEGIN:VCARD');
    vCard.push('VERSION:3.0');

    // Names
```

```
            const displayName =
(profile.fullName ||
profile.user?.username ||
'Contact').trim();

 vCard.push(`FN:${displayName}`);

            const parts =
displayName.split(/\s+/);

    const first = parts.length > 1 ?
parts[0] : '';

    const last = parts.length > 1 ?
parts.slice(1).join(' ') : parts[0];

  vCard.push(`N:${last};${first};;;`);

  // Organization and Title

    if (isFieldVisible('company') &&
profile.company)
vCard.push(`ORG:${profile.company
}`);

        if (isFieldVisible('jobTitle') &&
profile.jobTitle)
vCard.push(`TITLE:${profile.jobTitl
e}`);


   // Phones

        if (isFieldVisible('phone') &&
profile.contact?.phone) {

            const phone =
String(profile.contact.phone).replace(
/[^+0-9]/g, '');


vCard.push(`TEL;TYPE=CELL,VOI
CE;PREF=1:${phone}`);

  }

   // Emails
```

```
        if (isFieldVisible('email') &&
profile.contact?.email) {
vCard.push(`EMAIL;TYPE=INTER
NET,WORK;PREF=1:${profile.cont
act.email}`);
    }
    // Address
      if (isFieldVisible('location') &&
profile.contact?.location) {
                const label =
String(profile.contact.location).replac
e(/\r?\n/g, ', ');
vCard.push(`ADR;TYPE=WORK:;;$
{label};;;;`);
vCard.push(`LABEL;TYPE=WORK:
${label}`);
    }
    // Photo
                const photoUrl =
profile.profileImage?.secureUrl ||
profile.profileImage?.url;
    if (photoUrl) {
                const safePhoto =
photoUrl.startsWith('http://') ?
photoUrl.replace('http://', 'https://') :
photoUrl;

vCard.push(`PHOTO;VALUE=URI:$
{safePhoto}`);
    }
    // Website
                if (profile.website)
vCard.push(`URL:${profile.website}
`);
```

```
// Notes/Bio
        if (isFieldVisible('bio') && profile.bio) {
                const safeBio = String(profile.bio).replace(/\n/g, '\\n');
    vCard.push(`NOTE:${safeBio}`);
  }

// Metadata
vCard.push(`UID:${String(profile._id)}`);
            vCard.push(`REV:${new Date().toISOString()}`);
  vCard.push('END:VCARD');
  let vcfContent = vCard.join('\r\n');
        if (!vcfContent.endsWith('\r\n')) vcfContent += '\r\n';
            const fileName = `${(profile.fullName || 'contact').replace(/[^a-z0-9-_ ]/gi, '')}.vcf`;
    // Set headers by user agent for mobile compatibility
                const ua = String(req.headers['user-agent'] || '');
                const isIOS = /iPhone|iPad|iPod|Mac OS X/.test(ua) && /AppleWebKit/.test(ua);
                const isAndroid = /Android/i.test(ua);

  if (isAndroid) {
```

```
            res.setHeader('Content-Type',
'text/x-vcard; charset=utf-8');
   res.setHeader('Content-Disposition',
`attachment;
filename="${fileName}"`);
    } else {
            res.setHeader('Content-Type',
'text/vcard; charset=utf-8');
   res.setHeader('Content-Disposition',
`inline; filename="${fileName}"`);
    }
res.setHeader('X-Content-Type-Optio
ns', 'nosniff');
            res.setHeader('Cache-Control',
'public, max-age=60');
    return res.send(vcfContent);
  } catch (err) {
     console.error('Public vCard error:',
err);
                res.status(500).send('Error
generating vCard');
  }
};
```

Frontend: vCard Download Handler

File:
`nfc-card-react/src/components/BusinessCard.js`

```javascript
```

```
// Save Contact button handler
onClick: () => {
  // Log the action first
  onLogAction(card._id, {
    type: 'save_contact_click',
    label: 'Clicked Save Contact',
    url: ''
  });

  // Create vCard data with visibility respect
  const vCardFields = [
    'BEGIN:VCARD',
    'VERSION:3.0'
  ];

  // Add visible fields only
  if (isFieldVisible('fullName') && (profile?.fullName || user?.username)) {
vCardFields.push(`FN:${profile?.fullName || user?.username || 'Contact'}`);
  }

  if (isFieldVisible('jobTitle') && profile?.jobTitle) {
vCardFields.push(`TITLE:${profile.jobTitle}`);
  }
```

```
    if (isFieldVisible('company') &&
profile?.company) {
vCardFields.push(`ORG:${profile.co
mpany}`);
  }
      if (isFieldVisible('phone') &&
profile?.contact?.phone) {
vCardFields.push(`TEL:${profile.con
tact.phone}`);
  }

      if (isFieldVisible('email') &&
profile?.contact?.email) {
vCardFields.push(`EMAIL:${profile.
contact.email}`);
  }
  if (profile?.website) {
vCardFields.push(`URL:${profile.we
bsite}`);
  }
    if (isFieldVisible('location') &&
profile?.contact?.location) {
vCardFields.push(`ADR:;;${profile.c
ontact.location}`);
  }
        if (isFieldVisible('bio') &&
profile?.bio) {
vCardFields.push(`NOTE:${profile.b
io}`);
  }
  vCardFields.push('END:VCARD');
```

```
const vCardData = vCardFields.join('\r\n');

// Prefer opening the Contacts app via backend public vCard URL on mobile
const fileName = `${profile?.fullName || user?.username || 'contact'}.vcf`;
const ua = (navigator.userAgent || '').toLowerCase();
const isIOS = /iphone|ipad|ipod/.test(ua);
const isAndroid = /android/.test(ua);
const backendBase = 'https://onetapp-backend-website.onrender.com';
const hasProfileId = !!profile?._id;
if ((isIOS || isAndroid) && hasProfileId) {
// Use inline-served vCard from backend to trigger native Add to Contacts UI
const publicVcardUrl = `${backendBase}/api/profiles/public/${profile._id}/vcard`;
window.location.href = publicVcardUrl;
} else {
// Fallbacks: data URL for mobile without id, Blob download for desktop
const vcardDataUrl = `data:text/vcard;charset=utf-8,${encodeURIComponent(vCardData)}`;
```

```
    if (isIOS || isAndroid) {
                const a = document.createElement('a');
      a.href = vcardDataUrl;
      a.download = fileName;
      document.body.appendChild(a);
      a.click();
      document.body.removeChild(a);
    } else {
        const blob = new Blob([vCardData], { type: 'text/vcard;charset=utf-8' });
                const url = window.URL.createObjectURL(blob);
                const link = document.createElement('a');
      link.href = url;
      link.download = fileName;
      document.body.appendChild(link);
      link.click();
      document.body.removeChild(link);
      window.URL.revokeObjectURL(url);
    }
  }

  // Log the successful download
  onLogAction(card._id, {
    type: 'contact_downloaded',
```

```
    label: 'Contact Downloaded',
    url: ''
  });
}
```

```
---

## 2. Real-Time Engagement Analytics System

### 2.1 Card Scan Tracking

#### Backend: Tap Log Model

**File:**
`backend/models/tapLogModel.js`

```javascript
const mongoose = require('mongoose');

const tapLogSchema = new mongoose.Schema({
  cardId: { type: mongoose.Schema.Types.ObjectId, ref: 'Card' },
  eventId: { type: mongoose.Schema.Types.ObjectId, ref: 'Event', required: false },
  timestamp: { type: Date, default: Date.now },
  ip: String,
  ipHash: { type: String, index: true },
  geo: {
    // Consent level tracking
    consentLevel: {
      type: String,
```
```

```
    enum: ['full', 'basic', 'none'],
    default: 'none'
  },
  // Location data based on consent level
    barangay: String,    // Only if consentLevel === 'full'
    city: String,        // Only if consentLevel === 'basic' or 'full'
    province: String,    // Only if consentLevel === 'basic' or 'full'

  // Metadata
  timezone: String,
    method: String,  // 'browser_geolocation', 'ip_geolocation', 'unknown'
    timestamp: Date
  },
  userAgent: String,
  sessionId: String,
  actions: [
    {
      type: { type: String },
      label: String,
      mediaId: String,
      url: String,
      timestamp: Date
    }
```

```
 ]
});


// Efficient lookups by card/session/time window
tapLogSchema.index({ cardId: 1, sessionId: 1, timestamp: -1 });
// Enforce single document per cardId+sessionId
tapLogSchema.index({ cardId: 1, sessionId: 1 }, { unique: true });
module.exports = mongoose.model('TapLog', tapLogSchema);
```

Backend: Tap Logging Controller

File: `backend/controllers/tapController.js`

```javascript
exports.logTap = async (req, res) => {
  try {
    const body = req.body;
    if (!body || !body.cardId || !body.sessionId) {
      return res.status(400).json({ error: 'Missing cardId or sessionId' });
    }
    // Get client IP
    const clientIP = getClientIP(req);
```

```
        const ipHash = clientIP ? hmacSha256(clientIP) : undefined;

    // Process location data based on consent level
    let processedGeo = null;
    if (body.geo) {
        const inferredConsent = (body.geo.city || body.geo.province) ? 'basic' : undefined;
        const consentLevel = normalizeConsentLevel(body.geo.consentLevel, inferredConsent);
        if (consentLevel !== 'none') {
            const hasClientCityProvince = !!(body.geo.city || body.geo.province);
            if (hasClientCityProvince) {
                processedGeo = normalizeProvince({
                    consentLevel,
                    barangay: body.geo.barangay,
                    city: body.geo.city,
                    province: body.geo.province,
                    country: body.geo.country,
                    method: body.geo.method || 'browser_geolocation',
                    timestamp: new Date()
                });
            } else if (body.geo.latitude && body.geo.longitude) {
```

```
            // Use coordinates to get location data (coordinates are temporary, not stored)
                processedGeo = await getLocationData(
                    body.geo.latitude,
                    body.geo.longitude,
                    consentLevel
                );
            } else if (body.ip) {
                // Fallback to IP-based location if nothing provided
                processedGeo = await getLocationFromIP(body.ip, consentLevel);
            }
        }

        // Set processed geo data (null if no consent)
        let geo = processedGeo;
        if (geo) {
            const canonicalProvince = canonicalizeProvince(geo.province);
            const canonicalCity = canonicalizeCity(geo.city, canonicalProvince || geo.province);
            geo = {
                ...geo,
```

```
        canonicalCity: canonicalCity || undefined,
        canonicalProvince: canonicalProvince || undefined
      };
    }

    // Check if there's an active event for this card
        const activeEvent = await Event.getActiveEvent(body.cardId);

    let finalGeo = geo;
    let eventId = undefined;

        if (activeEvent && geo && geo.city) {
      eventId = activeEvent._id;
      finalGeo = {
        ...geo,
        city: activeEvent.location.city,
        province: activeEvent.location.province,
        method: 'event_location'
      };
    }

    const filter = { cardId: body.cardId, sessionId: body.sessionId };
    const update = {
      $setOnInsert: {
```

```
      cardId: body.cardId,
      sessionId: body.sessionId,
      userAgent: body.userAgent,
      ipHash: ipHash,
      actions: [{ type: 'business_card_viewed', label: 'Business Card Viewed', timestamp: new Date() }]
    },
    $set: {
      geo: geo || null,
      ...(eventId ? { eventId } : {}),
      timestamp: new Date()
    }
  };
  const options = { upsert: true, new: true };
  const doc = await TapLog.findOneAndUpdate(filter, update, options);
  return res.status(200).json(doc);
 } catch (err) {
  res.status(500).json({ error: err.message });
 }
};
```

Frontend: Tap Logging

File: `nfc-card-react/src/App.js`

```javascript
// Log tap event to backend once geolocation has resolved
const logTap = useCallback(async (cardId, eventId = null) => {
  try {
    // once-per-session guard per card to avoid duplicate view logs
    const onceKey = `viewed_${cardId}`;
    if (sessionStorage.getItem(onceKey) === '1') {
      return;
    }
    const deviceInfo = getDeviceInfo();
    const params = new URLSearchParams(window.location.search);
    const isPreview = params.get('preview') === '1';
    const tapData = {
      cardId: cardId,
      eventId: eventId,
      timestamp: new Date(),
      ip: '',
      geo: locationData || null,
      userAgent: deviceInfo.userAgent,
```

```
                sessionId: getOrCreateSessionId(),
    preview: isPreview,
    actions: [{
      type: 'business_card_viewed',
      label: 'Business Card Viewed',
      timestamp: new Date()
    }]
  };

  // If we have no city/province yet but have coords, include coords explicitly
            if (tapData.geo && (!tapData.geo.city && !tapData.geo.province) && tapData.geo.latitude && tapData.geo.longitude) {
    tapData.geo = { ...tapData.geo };
  }

            const API_BASE = process.env.REACT_APP_API_BASE || 'https://onetapp-backend-website.onrender.com';

  // Try to get client IP from a public service before sending
  try {
            const ipResp = await fetch('https://api.ipify.org?format=json', { cache: 'no-store' });
```

```
            const ipJson = await ipResp.json().catch(() => null);
      if (ipJson && ipJson.ip) {
        tapData.ip = ipJson.ip;
      }
    } catch {}
    // Send tap data
            const resp = await fetch(`${API_BASE}/api/taps`, {
      method: 'POST',
      headers: {
        'Content-Type': 'application/json'
      },
      body: JSON.stringify(tapData)
    });
      if (resp.ok) {
        sessionStorage.setItem(onceKey, '1');
      }
    } catch (error) {
      console.log('Tap logging failed (non-critical):', error);
    }
  }, [getOrCreateSessionId, getDeviceInfo, locationData]);
```

2.2 Location Tracking

Backend: IP Geolocation Service

File:

`backend/services/geocodingService.js`

```javascript
/**
 * Get location data from IP (fallback when geolocation fails)
 * @param {string} ip - IP address
 * @param {string} consentLevel - Consent level
 * @returns {Object|null} Location data or null
 */
async function getLocationFromIP(ip, consentLevel = 'none') {
  try {
    if (consentLevel === 'none') {
      return null;
    }

    // Try multiple IP geolocation services for better accuracy
    const sanitizedIp = (ip || '').toString().trim();
    const ipinfoToken = process.env.IPINFO_TOKEN || '';
    const ipgeoKey = process.env.IPGEOLOCATION_KEY || 'free';

    const ipServices = [
```

```
    {
        // ipapi allows specifying IP in the path
        url: `https://ipapi.co/${encodeURIComponent(sanitizedIp)}/json/`,
        headers: { 'User-Agent': 'OneTapp/1.0' }
    },
    {
        // ipinfo also allows IP in the path
        url: `https://ipinfo.io/${encodeURIComponent(sanitizedIp)}${ipinfoToken ? `?token=${encodeURIComponent(ipinfoToken)}` : ''}`,
        headers: { 'User-Agent': 'OneTapp/1.0' }
    },
    {
        // ipgeolocation.io supports ip query param
        url: `https://api.ipgeolocation.io/ipgeo?apiKey=${encodeURIComponent(ipgeoKey)}&ip=${encodeURIComponent(sanitizedIp)}`,
        headers: { 'User-Agent': 'OneTapp/1.0' }
    }
];

let data = null;
```

```
    for (const service of ipServices) {
      try {
        const response = await axios.get(service.url, {
          headers: service.headers,
          timeout: 5000
        });
        if (response.data && response.data.city) {
          data = response.data;
          break;
        }
      } catch (err) {
        console.log(`IP service ${service.url} failed:`, err.message);
        continue;
      }
    }

    if (!data) {
      return null;
    }

    const result = {
      consentLevel,
      method: 'ip_geolocation',
      timestamp: new Date()
    };

    if (consentLevel === 'full') {
```

```
        result.barangay = data.district ||
data.neighbourhood || data.suburb;
      result.city = data.city;
        result.province = data.region ||
data.state;
    } else if (consentLevel === 'basic')
{
      result.city = data.city;
        result.province = data.region ||
data.state;
    }
    return result;
  } catch (error) {
      console.error('All IP geolocation
services failed:', error);
      return null;
    }
}
```

```
#### Backend: Reverse Geocoding
Service

**File:**
`backend/services/geocodingService.j
s`

```javascript
/**
 * Reverse geocode coordinates with
multi-provider fallback and caching
 * @param {number} latitude
 * @param {number} longitude
```
```

```
 * @returns {Object|null}
 */
async function reverseGeocode(latitude, longitude) {
  try {
    const key = `${latitude},${longitude}`;
    const cached = reverseCache.get(key);
    if (cached && cached.expiresAt > Date.now()) {
      return cached.data;
    }
    // Provider 1: Nominatim (primary)
    const providers = [
      async () => {
        const response = await axios.get('https://nominatim.openstreetmap.org/reverse', {
          params: {
            lat: latitude,
            lon: longitude,
            format: 'json',
            addressdetails: 1,
            'accept-language': 'en'
          },
          headers: {
            'User-Agent': 'OneTapp/1.0 (contact@onetapp.app)'
          },
```

```
        timeout: 8000
      });
      const data = response.data || {};
      const addr = data.address || {};
      if (!addr) return null;
      return {
            barangay: addr.suburb || addr.neighbourhood || addr.village,
          city: addr.city || addr.town || addr.municipality || addr.village,
            province: addr.county || addr.state_district || addr.province || addr.state || addr.region,
        country: addr.country,
        timezone: data.timezone || null
      };
    },
    // Provider 2: BigDataCloud (no key required)
    async () => {
          const response = await axios.get('https://api.bigdatacloud.net/data/reverse-geocode-client', {
        params: {
          latitude,
          longitude,
          localityLanguage: 'en'
        },
        headers: {
```

```
            'User-Agent': 'OneTapp/1.0 (contact@onetapp.app)'
        },
        timeout: 8000
    });
    const d = response.data || {};
    if (!d) return null;
    return {
        city: d.city || d.locality || d.principalSubdivision || undefined,
        province: d.principalSubdivision || d.locality || undefined,
        country: d.countryName || undefined,
        timezone: d.timezone || null
    };
},
// Provider 3: maps.co (Nominatim mirror)
async () => {
    const response = await axios.get('https://geocode.maps.co/reverse', {
        params: {
            lat: latitude,
            lon: longitude,
            format: 'json'
        },
        headers: {
```

```
            'User-Agent': 'OneTapp/1.0 (contact@onetapp.app)'
        },
        timeout: 8000
      });
      const data = response.data || {};
      const addr = data.address || {};
      if (!addr) return null;
      return {
            barangay: addr.suburb || addr.neighbourhood || addr.village,
            city: addr.city || addr.town || addr.municipality || addr.village,
            province: addr.county || addr.state_district || addr.province || addr.state || addr.region,
            country: addr.country,
            timezone: null
          };
        }
      ];
let result = null;
    for (const provider of providers) {
      try {
        result = await provider();
            if (result && (result.city || result.province || result.country)) {
            break;
```

```
      }
    } catch (e) {
      continue;
    }
  }
  if (!result) return null;

      reverseCache.set(key, { data: result, expiresAt: Date.now() + REVERSE_TTL_MS });
  return result;
 } catch (error) {
    console.error('Reverse geocoding failed:', error);
  return null;
  }
}
```

```
#### Frontend: Location Consent and Tracking

**File:** `nfc-card-react/src/components/LocationConsent.js`

```javascript
const getLocationData = useCallback(async (consent) => {
 if (consent === 'none') {
  onLocationData(null);
  return;
```
```

```
  }

  let locationResult = {
    consentLevel: consent,
    method: 'unknown',
    timestamp: new Date()
  };

  // Fallback to IP-based location with multiple services
  if (locationResult.method === 'unknown') {
    try {
      // Try multiple IP geolocation services for better accuracy
      const ipServices = [
        'https://ipapi.co/json/',
        'https://ipinfo.io/json',
        'https://api.ipgeolocation.io/ipgeo?apiKey=free'
      ];

      let ipData = null;
      for (const service of ipServices) {
        try {
          const response = await fetch(service, { timeout: 5000 });
          if (response.ok) {
            ipData = await response.json();
            break;
          }
        } catch (err) {
```

```
                console.log(`IP  service
${service} failed:`, err);
        continue;
      }
    }

    if (ipData) {
            locationResult.method  =
'ip_geolocation';
      locationResult.ip = ipData.ip;
      if (consent === 'basic') {
                locationResult.city  =
ipData.city;
            locationResult.province  =
ipData.region || ipData.state;
            }
          }
        } catch (error) {
            console.log('All IP geolocation
services failed:', error);
        }
      }

      onLocationData(locationResult);
}, [onLocationData]);
```

2.3 Engagement Action Tracking

Backend: User Action Logging

File:
`backend/controllers/tapController.js`

```javascript
exports.logUserAction = async (req, res) => {
 try {
  // Basic validation
   if (!req.body || !req.body.cardId || !req.body.sessionId) {
   return res.status(400).json({ error: 'Missing cardId or sessionId' });
  }
        const hasActionArray = Array.isArray(req.body.actions) && req.body.actions.length > 0;
        if (!hasActionArray || !req.body.actions[0] || !req.body.actions[0].type) {
   return res.status(400).json({ error: 'Invalid action payload' });
  }
    // Add IP from request if not provided by frontend
  const actionData = { ...req.body };
  if (!actionData.ip) {
   actionData.ip = getClientIP(req);
  }
    const ipHash = actionData.ip ? hmacSha256(actionData.ip) : undefined;
   // Normalize consent on incoming action geo
  if (actionData.geo) {
```

```
            const inferredConsent =
(actionData.geo.city                ||
actionData.geo.province)  ?  'basic'  :
undefined;

        actionData.geo.consentLevel =
normalizeConsentLevel(actionData.g
eo.consentLevel, inferredConsent);

    }

            const  filter  =  {  cardId:
actionData.cardId,          sessionId:
actionData.sessionId };

// Prepare action to append

                const     incoming     =
actionData.actions[0];

    const newAction = {

      type: incoming.type,

      label: incoming.label || '',

      url: incoming.url || '',

      timestamp: new Date()

    };

        // Upsert and append action
atomically

                const    doc    =    await
TapLog.findOneAndUpdate(

      filter,

      {

        $setOnInsert: {

          cardId: actionData.cardId,

                                    sessionId:
actionData.sessionId,
```

```
                userAgent:
actionData.userAgent,
      ipHash: ipHash,
    },
    $set: {
      // refresh geo if supplied
        ...(actionData.geo ? { geo:
actionData.geo } : {}),
      timestamp: new Date()
    },
    $push: {
      actions: newAction
    }
  },
  { upsert: true, new: true }
);
    return res.status(200).json(doc);
  } catch (err) {
    console.error('logUserAction
error', err);
    res.status(500).json({ error:
err.message });
  }
}
```

Frontend: Action Logging

File: `nfc-card-react/src/App.js`

```javascript
// Log user action to backend
```

```
const logUserAction = useCallback(async (cardId, actionData) => {
 try {
   const deviceInfo = getDeviceInfo();
   const actionLog = {
     cardId: cardId,
     timestamp: new Date(),
     ip: '',
     geo: locationData || null,
     userAgent: deviceInfo.userAgent,
     sessionId: getOrCreateSessionId(),
     actions: [{
       type: actionData.type,
       label: actionData.label,
       url: actionData.url || '',
       timestamp: new Date()
     }]
   };
   // Include coords if present even without resolved address
   if (actionLog.geo && (!actionLog.geo.city && !actionLog.geo.province) && actionLog.geo.latitude && actionLog.geo.longitude) {
     actionLog.geo = { ...actionLog.geo };
   }
```

```
// debounce rapid-fire identical actions within 1s on the client
const actKey = `last_action_${cardId}_${actionLog.actions[0].type}_${actionLog.actions[0].url || ''}`;
const lastAt = parseInt(sessionStorage.getItem(actKey) || '0', 10);
const now = Date.now();
if (now - lastAt < 1000) {
  return;
}
sessionStorage.setItem(actKey, String(now));

const API_BASE = process.env.REACT_APP_API_BASE || 'https://onetapp-backend-website.onrender.com';

// Try to get client IP before sending action
try {
  const ipResp = await fetch('https://api.ipify.org?format=json', { cache: 'no-store' });
  const ipJson = await ipResp.json().catch(() => null);
  if (ipJson && ipJson.ip) {
    actionLog.ip = ipJson.ip;
  }
```

```
    } catch {}

            const resp = await fetch(`${API_BASE}/api/taps/action`, {
      method: 'POST',
      headers: {
        'Content-Type': 'application/json'
      },
      body: JSON.stringify(actionLog)
    });
    if (!resp.ok) {
            const text = await resp.text().catch(() => '');
      console.error('Action log failed', resp.status, resp.statusText, text);
    } else {
      const result = await resp.json();
      console.log('User action logged successfully:', result);
    }
  } catch (error) {
      console.error('Action logging failed:', error);
  }
}, [getDeviceInfo, locationData, getOrCreateSessionId]);
```

```
---
```

3. Cloud-Based Dashboard for Analytics Visualization

3.1 Analytics Data Aggregation

Backend: Enhanced Analytics Controller

File: `backend/controllers/enhancedAnalyticsController.js`

```javascript
const getEnhancedAnalytics = asyncHandler(async (req, res) => {
  const cardId = req.params.id;
  const { period = '30d' } = req.query;
  const objectId = new (require('mongoose').Types.ObjectId)(cardId);

  // Calculate date range
  const endDate = new Date();
  const startDate = new Date();
  switch (period) {
    case '7d': startDate.setDate(endDate.getDate() - 7); break;
    case '30d': startDate.setDate(endDate.getDate() - 30); break;
    case '90d': startDate.setDate(endDate.getDate() - 90); break;
    default: startDate.setDate(endDate.getDate() - 30);
```

```
}

// Get basic analytics data
const [
  timeline,
  topCities,
  deviceData,
  actionDistribution,
  hourlyData,
  recentActivity,
  tapLocations
] = await Promise.all([
    getTimelineData(objectId, startDate, endDate),
    getTopCitiesData(objectId, startDate, endDate),
    getDeviceData(objectId, startDate, endDate),
    getActionDistribution(objectId, startDate, endDate),
    getHourlyData(objectId, startDate, endDate),
    getRecentActivity(objectId, startDate, endDate),
    getTapLocations(objectId, startDate, endDate)
  ]);

  // Generate smart insights
    const insights = generateSmartInsights({
      timeline,
      topCities,
```

```
    deviceData,
    actionDistribution,
    hourlyData,
    period
  });
  // Generate recommendations
        const recommendations =
generateRecommendations({
    timeline,
    topCities,
    deviceData,
    actionDistribution,
    hourlyData,
    insights
  });
  // Calculate performance metrics
        const performanceMetrics =
calculatePerformanceMetrics({
    timeline,
    topCities,
    deviceData,
    actionDistribution,
    period
  });
  res.status(200).json({
    success: true,
    data: {
      timeline,
```

```
    topCities,
    deviceData,
    actionDistribution,
    hourlyData,
    recentActivity,
    tapLocations,
    insights,
    recommendations,
    performanceMetrics
  }
 });
});
// Helper functions for data aggregation
const getTimelineData = async (cardId, startDate, endDate) => {
 return await TapLog.aggregate([
  { $match: { cardId, timestamp: { $gte: startDate, $lte: endDate } } },
  { $group: { _id: { $dateToString: { format: "%Y-%m-%d", date: "$timestamp", timezone: "Asia/Manila" } }, count: { $sum: 1 } } },
  { $sort: { _id: 1 } }
 ]);
};
const getTopCitiesData = async (cardId, startDate, endDate) => {
 return await TapLog.aggregate([
```

```
    { $match: { cardId, timestamp: {
$gte: startDate, $lte: endDate } } },
   { $addFields: {
                groupCity: { $ifNull:
['$geo.canonicalCity', '$geo.city'] },
             groupProvince: { $ifNull:
['$geo.canonicalProvince',
'$geo.province'] }
     }
   },
    { $match: { groupCity: { $exists:
true, $ne: null } } },
   { $group: {
      _id: '$groupCity',
      count: { $sum: 1 },
                province: { $first:
'$groupProvince' }
     }
    },
    { $sort: { count: -1 } },
    { $limit: 10 }
  ]);
};
const getDeviceData = async (cardId,
startDate, endDate) => {
 return await TapLog.aggregate([
    { $match: { cardId, timestamp: {
$gte: startDate, $lte: endDate } } },
      { $addFields: { deviceType: {
$cond: [ { $regexMatch: { input:
```

```
'$userAgent', regex: /Mobile|Android|iPhone/i } },
'Mobile', 'Desktop' ] } } },

    { $group: { _id: '$deviceType', count: { $sum: 1 } } },

  { $sort: { count: -1 } }

 ]);

};


const getActionDistribution = async (cardId, startDate, endDate) => {

 return await TapLog.aggregate([

   { $match: { cardId, timestamp: { $gte: startDate, $lte: endDate }, 'actions.0': { $exists: true } } },

  { $unwind: '$actions' },

    { $group: { _id: '$actions.type', count: { $sum: 1 } } },

  { $sort: { count: -1 } }

 ]);

};

const getHourlyData = async (cardId, startDate, endDate) => {

 return await TapLog.aggregate([

   { $match: { cardId, timestamp: { $gte: startDate, $lte: endDate } } },

    { $project: { hour: { $toInt: { $dateToString: { format: "%H", date: "$timestamp", timezone: "Asia/Manila" } } } } },

   { $group: { _id: '$hour', count: { $sum: 1 } } },
```

```
    { $sort: { _id: 1 } }
  ]);
};

const getTapLocations = async (cardId, startDate, endDate) => {
        const tapLogs = await TapLog.find({ cardId, timestamp: { $gte: startDate, $lte: endDate } })
          .select('geo.city geo.province geo.consentLevel timestamp');
  const cityGroups = new Map();
  tapLogs.forEach(tap => {
      if (tap.geo && tap.geo.city && tap.geo.consentLevel !== 'none') {
      const city = tap.geo.city;
      if (!cityGroups.has(city)) {
        cityGroups.set(city, {
          city: city,
          province: tap.geo.province,
          count: 0,
          timestamps: []
        });
      }
                const group = cityGroups.get(city);
      group.count += 1;
group.timestamps.push(tap.timestamp);
    }
  });
```

return Array.from(cityGroups.values()).map(zone => ({
  city: zone.city,
  province: zone.province,
  count: zone.count,
  zoneRadius: Math.max(2000, Math.min(8000, 2000 + (zone.count * 200))),
  timestamps: zone.timestamps
}));
};
```

#### Backend: Card Analytics Controller

**File:** `backend/controllers/cardController.js`

```javascript
const getCardAnalytics = asyncHandler(async (req, res) => {
  const cardId = req.params.id;
  const { period = '30d' } = req.query;

  const objectId = new (require('mongoose').Types.ObjectId)(cardId);

  // Calculate date range
  const endDate = new Date();
  const startDate = new Date();

```
 switch (period) {
                    case '7d': startDate.setDate(endDate.getDate() - 7); break;
                    case '30d': startDate.setDate(endDate.getDate() - 30); break;
                    case '90d': startDate.setDate(endDate.getDate() - 90); break;
                    default: startDate.setDate(endDate.getDate() - 30);
  }
  // Timeline (taps per day)
        const timeline = await TapLog.aggregate([
            { $match: { cardId: objectId, timestamp: { $gte: startDate, $lte: endDate } } },
    { $group: { _id: { $dateToString: { format: "%Y-%m-%d", date: "$timestamp", timezone: "Asia/Manila" } }, count: { $sum: 1 } } },
    { $sort: { _id: 1 } }
  ]);
  // Top cities
        const topCities = await TapLog.aggregate([
            { $match: { cardId: objectId, timestamp: { $gte: startDate, $lte: endDate }, 'geo.city': { $exists: true, $ne: null } } },
```

```
    { $group: {
      _id: '$geo.city',
      count: { $sum: 1 },
      province: { $first: '$geo.province' }
    }
  },
  { $sort: { count: -1 } },
  { $limit: 10 }
 ]);
 // Device breakdown
      const deviceData = await TapLog.aggregate([
        { $match: { cardId: objectId, timestamp: { $gte: startDate, $lte: endDate } } },
        { $addFields: { deviceType: { $cond: [ { $regexMatch: { input: '$userAgent', regex: /Mobile|Android|iPhone/i } }, 'Mobile', 'Desktop' ] } } },
        { $group: { _id: '$deviceType', count: { $sum: 1 } } },
   { $sort: { count: -1 } }
 ]);
 // Action distribution
    const actionDistribution = await TapLog.aggregate([
        { $match: { cardId: objectId, timestamp: { $gte: startDate, $lte:
```

```
endDate }, 'actions.0': { $exists: true } } },

  { $unwind: '$actions' },

    { $group: { _id: '$actions.type', count: { $sum: 1 } } },

  { $sort: { count: -1 } }

 ]);

  // Get hourly data for peak hours analysis

      const hourlyData = await TapLog.aggregate([

      { $match: { cardId: objectId, timestamp: { $gte: startDate, $lte: endDate } } },

    { $group: { _id: { $hour: { date: "$timestamp", timezone: "Asia/Manila" } }, count: { $sum: 1 } } },

  { $sort: { _id: 1 } }

 ]);

      // Tap locations for map visualization - privacy-safe city zones only

      const tapLogs = await TapLog.find({ cardId: objectId, timestamp: { $gte: startDate, $lte: endDate } })

      .select('geo.city geo.province geo.consentLevel timestamp');

 const cityGroups = new Map();

 tapLogs.forEach(tap => {
```

```
      if (tap.geo && tap.geo.city &&
tap.geo.consentLevel !== 'none') {
    const city = tap.geo.city;
    if (!cityGroups.has(city)) {
      cityGroups.set(city, {
        city: city,
        province: tap.geo.province,
        count: 0,
        timestamps: []
      });
    }
                    const group =
cityGroups.get(city);
    group.count += 1;
group.timestamps.push(tap.timestam
p);
    }
  });
  // Convert to array with privacy-safe
zone data
            const tapLocations =
Array.from(cityGroups.values()).map
(zone => ({
    city: zone.city,
    province: zone.province,
    count: zone.count,
        zoneRadius: Math.max(2000,
Math.min(8000, 2000 + (zone.count
* 200))),
```

```
 timestamps: zone.timestamps

 }));

 // Calculate summary metrics

        const totalTaps =
timeline.reduce((sum, item) => sum
+ item.count, 0);

 const totalViews = totalTaps;

    const provincesReached = new
Set(topCities.map(city =>
city.province)).size;

  const engagementRate = totalTaps >
0 ?
Math.round((actionDistribution.reduc
e((sum, action) => sum +
action.count, 0) / totalTaps) * 100) :
0;

 res.status(200).json({
  success: true,
  data: {
   timeline,
   topCities,
   deviceData,
   actionDistribution,
   recentActivity,
   tapLocations,
   hourlyData,
   summary: {
    totalTaps,
    totalViews,
    provincesReached,
    engagementRate
```

```
    }
  }
 });
});
```

3.2 Dashboard Visualization Components

Frontend: Analytics Service

File:
`onetapp-fresh/src/services/cardService.js`

```javascript
// Get enhanced analytics with smart insights
async getEnhancedAnalytics(cardId, period = '30d') {
 try {
  const token = localStorage.getItem('token');
  if (!token) {
   throw new Error('No authentication token found');
  }
  const response = await fetch(`${API_BASE_URL}/cards/${cardId}/analytics-enhanced?period=${period}`, {
   method: 'GET',
   headers: {
```

```
                'Content-Type': 'application/json',
                'Authorization': `Bearer ${token}`
            }
        });

        if (!response.ok) {
            const errorData = await response.json().catch(() => ({}));
            throw new Error(errorData.message || 'Failed to fetch enhanced analytics');
        }

        const data = await response.json();
        return data.data;
    } catch (error) {
        console.error('Get enhanced analytics error:', error);
        throw error;
    }
}
```

Frontend: Analytics Dashboard Component

File: `onetapp-fresh/src/components/basic/sections/AnalyticsSuiteSection.jsx`

```javascript
// Load tap locations and summary for selected card
```

```
useEffect(() => {
  const loadAnalytics = async () => {
    try {
      if (!selectedCard) {
        setMapPoints([]);
        setTimelineData([]);
        setActionDistribution([]);
        setDeviceData([]);
        setHourlyData([]);
        setTopCities([]);
        setTopProvinces([]);
        return;
      }
                const data = await cardService.getEnhancedAnalytics(selectedCard, period);
        const pts = data?.tapLocations || [];
        setMapPoints(pts);
        // Update chart data from backend
        if (data?.timeline) {
          setTimelineData(data.timeline);
        }
        if (data?.actionDistribution) {
          setActionDistribution(data.actionDistribution);
        }
```

```
    if (data?.deviceData) {
      setDeviceData(data.deviceData);
    }
    if (data?.hourlyData) {
      setHourlyData(data.hourlyData);
    }
    if (data?.topCities) {
      setTopCities(data.topCities);
    }

// Compute provinces from tapLocations
    if (pts && pts.length > 0) {
      const total = pts.reduce((sum, p) => sum + (p.count || 0), 0) || 0;
      const byProvince = new Map();
      pts.forEach(p => {
        const key = p.province || 'Unknown Province';
        const prev = byProvince.get(key) || { _id: key, count: 0 };
        prev.count += (p.count || 0);
        byProvince.set(key, prev);
      });
      const list = Array.from(byProvince.values()).sort((a, b) => b.count - a.count).map(item => ({
        _id: item._id,
        count: item.count,
```

```
                percentage: total > 0 ?
(item.count / total) * 100 : 0
      }));
      setTopProvinces(list);
    } else {
      setTopProvinces([]);
    }
    // Enhanced fields
    setInsights(data?.insights || []);
setRecommendations(data?.recomme
ndations || []);

setPerformanceMetrics(data?.perform
anceMetrics || null);
      // Update top overview counters
from backend summary
    if (data?.summary) {
      setOverviewState(prev => ({
        ...prev,
                              totalTaps:
data.summary.totalTaps || 0,
                              totalViews:
data.summary.totalViews || 0,
                              geographicReach:
data.summary.provincesReached || 0,
                              engagementRate:
data.summary.engagementRate || 0,
                              conversionRate:
data.summary.conversionRate || 0,
```

```
                sessionDuration:
data.summary.avgSessionMinutes ||
0,
                bounceRate:
data.summary.bounceRate ??
prev.bounceRate
      }));
    }
  } catch (e) {
    console.error('Failed to load card
analytics:', e);
    setMapPoints([]);
    setTimelineData([]);
    setActionDistribution([]);
    setDeviceData([]);
    setHourlyData([]);
    setTopCities([]);
    setTopProvinces([]);
    setInsights([]);
    setRecommendations([]);
    setPerformanceMetrics(null);
  }
};
loadAnalytics();
}, [selectedCard, period]);
```

Frontend: Chart Visualization

File:
`onetapp-fresh/src/components/basic/sections/AnalyticsSuiteSection.jsx`

```javascript

// Enhanced Engagement Over Time Chart

<div className="bg-white rounded-xl shadow-sm border border-gray-200 p-6">

  <div className="flex items-center justify-between mb-4">

    <h3 className="text-lg font-semibold text-gray-900">Engagement Over Time</h3>

    <div className="flex space-x-2">

      <button className="px-3 py-1 text-xs bg-purple-100 text-purple-700 rounded-full">

        {timelineData?.length || 0} Days

      </button>

      <button className="px-3 py-1 text-xs bg-green-100 text-green-700 rounded-full">

        {timelineData?.reduce((sum, item) => sum + item.count, 0) || 0} Total Taps

      </button>

    </div>

  </div>

  {/* Enhanced Line Chart */}

  <div className="h-64 mb-4">

    <Line

      data={prepareTapChartData()}

      options={{
```

```
responsive: true,
maintainAspectRatio: false,
plugins: {
 legend: {
  display: true,
  position: 'top',
  labels: {
   usePointStyle: true,
   padding: 20,
   font: {
    size: 12
   }
  }
 },
 tooltip: {
  mode: 'index',
  intersect: false,
   backgroundColor: 'rgba(0, 0, 0, 0.8)',
  padding: 12,
   titleFont: { size: 14, weight: 'bold' },
  bodyFont: { size: 12 },
  callbacks: {
   label: function(context) {
                return `${context.dataset.label}: ${context.parsed.y} taps`;
   }
```

```
    }
   }
  },
  scales: {
   x: {
    display: true,
    grid: {
     display: false
    },
    ticks: {
     font: { size: 11 },
     maxRotation: 45,
     minRotation: 45
    }
   },
   y: {
    display: true,
    beginAtZero: true,
    grid: {
     color: 'rgba(0, 0, 0, 0.05)'
    },
    ticks: {
     font: { size: 11 },
     stepSize: 1
    }
   }
  },
  interaction: {
```

```
      mode: 'nearest',                    </div>
      axis: 'x',                        </div>
      intersect: false                  ```
    }
  }}                                    ---
/>
```

B. EVALUATION TOOL

Test Cases for the Admin

Task ID	Test Descriptions	Expected Result	Result	Status
1	View All Users	The admin can view a comprehensive list of all registered users with search and filter capabilities, including user details, subscription status, and account activity.	Successful	5/5 = 100% Passed
2	Manage User Accounts	The admin can add, edit, activate, deactivate, or delete user accounts while maintaining data integrity and proper access controls.	Successful	5/5 = 100% Passed
3	View All Profiles	The admin can access and view all user profiles across the platform, including profile information, statistics, and associated NFC cards.	Successful	5/5 = 100% Passed
4	Manage Profiles	The admin can edit profile information, view profile statistics, and delete profiles when necessary.	Successful	5/5 = 100% Passed
5	View All NFC Cards	The admin can view a complete list of all NFC cards in the system, including card status, activation state, and	Successful	5/5 = 100% Passed

		associated user information.		
6	Manage NFC Cards	The admin can activate, deactivate, view card details, manage card assignments, and access card analytics.	Successful	5/5 = 100% Passed
7	Manage Subscriptions	The admin can view all subscriptions, manage subscription status, upgrade or downgrade plans, view subscription history, and handle cancellations.	Successful	5/5 = 100% Passed
8	View Platform Analytics	The admin can access platform-wide analytics including user growth metrics, card usage statistics, revenue analytics, geographic distribution, device analytics, and time-based trends.	Successful	5/5 = 100% Passed
9	Generate Reports	The admin can generate custom reports, export data in various formats (CSV, PDF, Excel), schedule recurring reports, and use report templates.	Successful	5/5 = 100% Passed
10	View Activity Logs	The admin can view system-wide activity logs, filter by user, action, or date, search activity logs, and export logs for auditing purposes.	Successful	5/5 = 100% Passed

11	Manage Backups	The admin can create manual backups, view backup history, restore from backups, schedule automatic backups, and download backup files.	Successful	5/5 = 100% Passed
12	Manage Support Tickets	The admin can view all support tickets, filter by status or priority, assign tickets to staff, respond to tickets, and close resolved tickets.	Successful	5/5 = 100% Passed
13	Manage Notifications	The admin can create and manage system-wide notifications and announcements for users, including important updates and feature announcements.	Successful	5/5 = 100% Passed

Test Case for Card Owner

Task ID	Test Descriptions	Expected Result	Result	Status
1	Register Account	Users can successfully create a new account by providing required information (username, email, password) and receive confirmation.	Successful	5/5 = 100% Passed
2	Login to Dashboard	Users can securely log in using valid credentials and are redirected to their Basic Dashboard with	Successful	5/5 = 100% Passed

		appropriate access based on subscription status.		
3	View Dashboard Overview	Users can view their dashboard overview displaying key metrics including NFC card count, total profiles, total views/taps, and taps today.	Successful	5/5 = 100% Passed
4	Manage Profile	Users can create, edit, and update their profile information including name, title, bio, contact information, profile photo, and social media links.	Successful	5/5 = 100% Passed
5	View Analytics	Users can access detailed analytics about their NFC card usage including tap analytics (daily, weekly, monthly), view counts, trends, geographic data, device type analytics, and social link click tracking.	Successful	5/5 = 100% Passed
6	Export Analytics Reports	Users can export analytics data in various formats (PDF, CSV) for external analysis and reporting.	Successful	5/5 = 100% Passed
7	View Activity Log	Users can view their complete activity history, filter by activity type, search activity logs, and view timestamps and details.	Successful	5/5 = 100% Passed
8	Manage Bookings	Users can view meeting requests, accept or decline bookings, manage their	Successful	5/5 = 100% Passed

		calendar, and track booking history.		
9	View Notifications	Users can view system notifications and announcements, mark notifications as read/unread, and access important updates.	Successful	5/5 = 100% Passed
10	Manage Billing	Users can view their current subscription plan, payment history, upgrade options, add-on management, and download invoices.	Successful	5/5 = 100% Passed
11	Access Support	Users can access help center articles, contact support through forms, submit support tickets, and access FAQ resources.	Successful	5/5 = 100% Passed
12	View Virtual Business Card	Users can view their virtual business card preview and access the shareable link for their NFC card.	Successful	5/5 = 100% Passed

Test Cases for the NFC Card Visitor

Task ID	Test Descriptions	Expected Result	Result	Status
1	Access Card via NFC Tap	Visitors can successfully tap an NFC card with their smartphone and the business card interface automatically opens in	Successful	5/5 = 100% Passed

		their browser without requiring app installation.		
2	Access Card via Web Link	Visitors can access the business card by clicking a shared web link, and the card loads correctly with all profile information displayed.	Successful	5/5 = 100% Passed
3	Access Card via QR Code	Visitors can scan a QR code printed on the physical card and the business card opens correctly in their browser.	Successful	5/5 = 100% Passed
4	View Profile Information	Visitors can view complete profile information including profile image, name, title, company, location, and bio section.	Successful	5/5 = 100% Passed
5	View Social Media Links	Visitors can view and access all connected social media platforms, and clicking links opens profiles in new tabs with click tracking.	Successful	5/5 = 100% Passed
6	View Featured Links	Visitors can view featured links (up to 3 visible), access additional links through modal view, and click links to open in new tabs.	Successful	5/5 = 100% Passed
7	View Gallery	Visitors can browse the image/media gallery, open items in modal view, navigate through gallery	Successful	5/5 = 100% Passed

		items using swipe or click, and close modal to return.		
8	Share Business Card	Visitors can share the business card using native share dialog (mobile) or copy link (desktop), and the shared link works correctly.	Successful	5/5 = 100% Passed
9	Save Contact Information	Visitors can save contact information to their phone using native 'Add to Contacts' interface (mobile) or download .vcf file (desktop).	Successful	5/5 = 100% Passed
10	Request Meeting (Book Now)	Visitors can fill out and submit a meeting request form including name, contact information, meeting type, preferred date/time, and purpose, and receive confirmation.	Successful	5/5 = 100% Passed
11	Get Directions	Visitors can click the directions button to open Google Maps with the card owner's location (if location is visible).	Successful	5/5 = 100% Passed
12	Request Quote	Visitors can click the quote button to open their email client with a pre-filled quote request (if email is visible).	Successful	5/5 = 100% Passed
13	View on Mobile Device	The business card interface displays correctly on mobile devices with optimized layout, touch-friendly	Successful	5/5 = 100% Passed

		interactions, and native feature support.		
14	View on Desktop Device	The business card interface displays correctly on desktop devices with full layout, hover effects, and keyboard navigation support.	Successful	5/5 = 100% Passed

Onetapp Expert Evaluation Questionnaire — ISO/IEC 25010

Development of an Intelligent Business Card using NFC with Real-Time Engagement Analytics

Thank you for participating in the expert evaluation of Onetapp. This questionnaire follows the ISO/IEC 25010 software quality model. Please rate each item based on your experience.

Participant & Test Information

Name (optional)	Joanne	**Role / Department**	IT Professional
Email / Contact (optional)		**Date**	
Modules / Scenarios Tested		**Time Started – Ended**	

Likert scale below by placing a checkmark (✔) under the appropriate rating:

4 - Strongly Agree

3 - Agree

2 - Disagree

1 - Strongly Disagree

Usability

Question	4	3	2	1
1. The admin and user dashboards are intuitive and easy to navigate.				
2. The forms for creating or updating business cards and profiles are clearly labeled and easy to complete.				

3. The map and analytics features (e.g., zoom, filter, export) are easy to understand and use.				
4. The system feedback (such as toast messages, modals, or error alerts) clearly guides the user on any required next steps,				

comments/feedback :

Functionality

Question	4	3	2	1
1. The card and profile management features include all required fields and actions, functioning correctly from start to finish.				
2. The sharing events (tap logs) and analytics data are correctly recorded and integrated with the backend.				
3. The subscription management and checkout processes correctly handle plan changes and generate appropriate receipts.				
4. The notifications, announcements, and messaging features behave as intended.				
5. The export, reporting, and backup features produce accurate and complete outputs.				

comments/feedback :

Reliability

Question	4	3	2	1
1. The common user workflows complete without crashes or blocking errors				
2. The user data persists correctly across sessions and page refreshes.				
3. The file uploads succeed reliably for all supported file types and sizes.				
4. The system handles network failures gracefully (e.g., provides clear retry instructions).				
5. The system logs and audit trails consistently record key user and system actions.				

comments/feedback :

Efficiency

Question	4	3	2	1
1. The tasks (e.g., creating cards, updating profiles, running reports) complete within an acceptable time.				
2. The system response remains acceptable even with larger datasets (e.g., many users, taps, or orders).				
3. The search, filtering, and pagination features allow finding information with minimal effort.				
4. The typical user tasks execute quickly with minimal delays.				
5. The system significantly improves speed compared to equivalent manual processes.				

comments/feedback :

Security

Question	4	3	2	1
1. The authentication and authorization correctly enforce access privileges for each user role.	1			
2. The input validation and rate limiting mechanisms protect the system against common abuses (e.g., invalid requests or excessive usage).				
3. Sensitive information (e.g., API tokens or secrets) is not exposed to clients or logs.				
4. The file upload feature enforces allowed file types and size limits, and uploaded files are stored securely with proper access controls.				
5. The payment webhooks and subscription update processes are implemented securely and handle repeated requests idempotently.				

comments/feedback

Overall Satisfaction

Question	4	3	2	1
1. The system effectively meets its stated project objectives.				
2. The solution appears production-ready and suitable for the intended users.				

3. The benefits of the solution are clear to both administrators and end-users.				
4. The solution could be deployed after only minor refinements.				
5. The overall system quality and maintainability are satisfactory.				

comments/feedback :

OneTapp UAT Questionnaire — ISO/IEC 25010

A Web-Based Extension Management System for BSU TNEU - Lipa

Thank you for participating in the User Acceptance Testing (UAT) of OneTapp. This questionnaire follows the ISO/IEC 25010 software quality model. Please rate each item based on your experience.

Participant & Test Information

Name (optional)		**Role / Department**	
Email / Contact (optional)		**Date**	
UAT Cycle / Build Version		**Test Environment**	
Modules / Scenarios Tested		**Time Started – Ended**	
Notes (optional)		**Reviewer (if any)**	

Instructions

- Execute the assigned scenarios or explore the relevant modules.
- Put a check (✔) in the box for your rating.
- If you rate 3 or below, please add a short comment.
- Log any problems in the Defect Log and note the Defect ID in your comments.

Rating Scale

1 Strongly Disagree	**2 Disagree**	**3 Neutral**	**4 Agree**

A. Usability

Statement (ISO/IEC 25010 mapping)	1	2	3	4	Comments
The interface is easy to understand on first use.					
Terms, icons, and labels are clear and consistent.					
I can find important actions quickly (share, edit profile).					
Error messages tell me how to fix issues.					
The process of tapping and exchanging business card information using NFC feels straightforward and intuitive.					

B. Functionality

Statement (ISO/IEC 25010 mapping)	1	2	3	4	Comments

I can set up my card/profile without help.					
Tapping/sharing works reliably across phones/NFC readers.					
Analytics (tap counts/visits) look correct for my activity.					
Orders/subscriptions work as described.					
All features work as expected without issues.					
The NFC feature consistently transfers my contact information without errors or delays.					

C. Reliability

Statement (ISO/IEC 25010 mapping)	1	2	3	4	Comments
No crashes or freezes during normal use.					
My NFC business card worked reliably during each use without interruptions or failed transfers.					
The system is available when I need it.					

I can retry or recover from failures without losing work.					
Results (analytics/taps) are consistent across sessions/devices.					

D. Efficiency

Statement (ISO/IEC 25010 mapping)	1	2	3	4	Comments
Screens load quickly (dashboard, analytics, profile).					
Actions respond promptly (save, share, tap logging).					
Reports/analytics refresh in acceptable time.					
The system does not slow down my device.					
Works acceptable on mobile data (LTE/5G).					
Using NFC to share my business card saves time compared to other methods					

E. Security & Privacy

Statement (ISO/IEC 25010 mapping)	1	2	3	4	Comments
Login and sessions feel secure (e.g., timeouts, re-auth).					
Only authorized users can access my data.					
Sensitive fields (contact/payment-related) appear protected.					
I understand how my data is used/stored (privacy).					
I trust OneTapp to handle my information responsibly.					

F. Compatibility & Interoperability

Statement (ISO/IEC 25010 mapping)	1	2	3	4	Comments
It works well on my device and browser/app version.					
Sharing works across iOS and Android devices.					
Exports (CSV) open correctly in Excel/Google Sheets.					

Links/pages render correctly on social/messaging apps.					
NFC tap works with typical phone cases/accessories.					

Acceptance Decision

☐ Accept as is ☐ Accept with minor fixes ☐ Reject – needs major fixes

Remarks: _____

C. Users Manual

ONETAPP
USER MANUAL

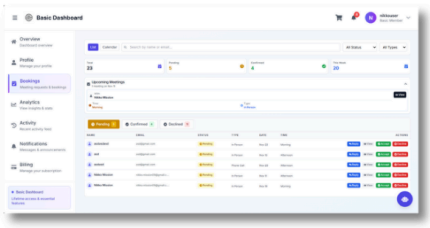
one-tapp.com
onetapp.info@gmail.com

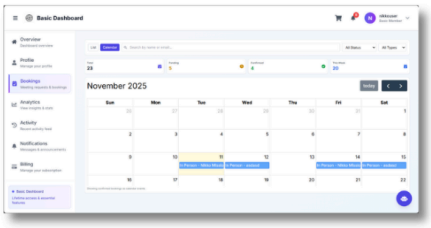
Purpose: The Profile section lets you view and manage all profile information that appears on your virtual NFC card, including personal details, contact info, social links, and gallery content.

How to Use:

- View your profile: see your profile picture, name, job title, company, contact information, bio, social links, featured links, and gallery items.
- Edit your profile: click the pencil icon (top right) to open the Edit Profile modal.
- In the Edit Profile modal, use the tabs to update:
- Basic Info — name, job title, company, bio
- Contact — email and phone
- Social Media — add or update social links
- Featured Links — add or update featured website links
- Gallery — manage gallery images
- Business Hours — set your availability
- Visibility — choose which information appears on your card using the checkboxes
- Save changes: click Save Changes in the modal, or Cancel to discard.
- View your live card: click the eye icon (top right) to preview how your card appears to others.
- Refresh: click the refresh icon (top right) to reload your profile data.

Bookings/Appointments



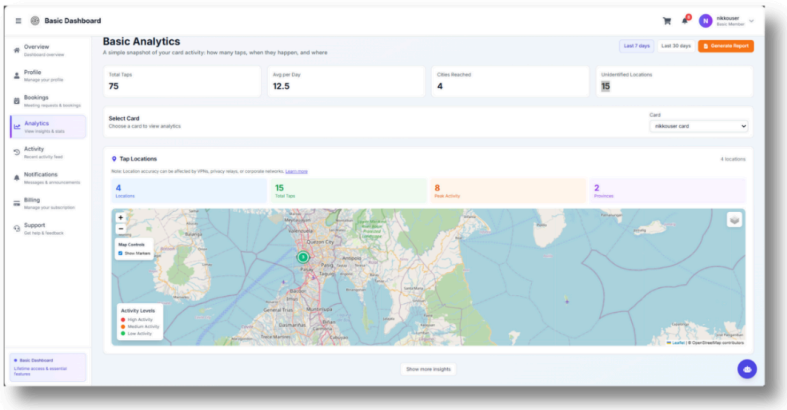


Purpose: The Bookings section is a central hub for managing meeting requests and scheduled appointments, providing an overview of booking statuses and tools to respond to each request.

How to Use:

- Review booking summaries at the top: Total (all bookings), Pending (awaiting action), Confirmed (accepted), Declined (rejected), and This Week (current week).
- Check the Upcoming Meetings card for your next scheduled meeting; click View to see details.
- Switch views: use the List tab for a detailed table, or the Calendar tab to see bookings on a monthly calendar.
- Search and filter: use the Search by name or email... bar to find specific bookings, and use the All Status and All Types dropdowns to narrow results.
- In List view, review each booking's name, email, status, type, date, and time.
- Take actions: use Reply to message the requester, View for full details, Accept to confirm, or Decline to reject.
- In Calendar view, navigate months with the arrow buttons or click today to return to the current date; confirmed bookings appear as colored blocks on their dates.

Analytics Section

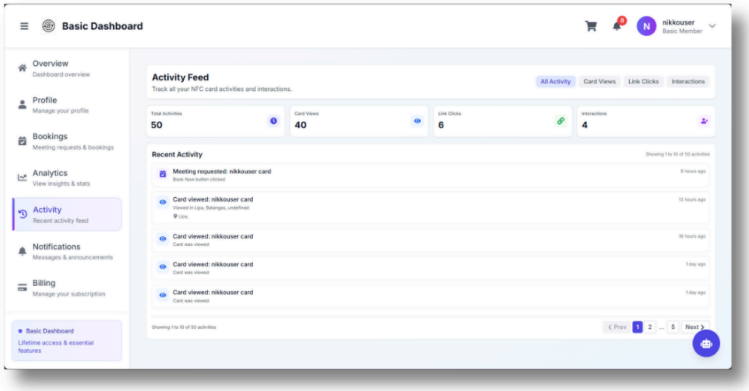


Purpose: The Analytics section provides a detailed overview of the card owner's virtual business card performance, showing key metrics related to card taps, geographical reach, and activity trends.

How to Use:

- Review key metrics at the top: Total Taps (total taps), Avg per Day (average daily taps), Cities Reached (number of cities), and Unidentified Locations (taps without location data).
- Select a card: if you have multiple cards, use the Card dropdown (top right) to choose which card's analytics to view.
- Generate reports: click Generate Report (top right) to create a detailed activity report.
- Filter by time: use Last 7 days or Last 30 days to view data for specific periods.
- Explore tap locations: the Tap Locations map shows where your card has been tapped, displaying location count, total taps, peak activity, and provinces reached.
- Use map controls: zoom with the + and - buttons, and toggle Show Markers to see tap points on the map.
- Understand activity levels: refer to the legend (red for High, orange for Medium, green for Low) to see tap intensity at different locations.
- Get more insights: click Show more insights at the bottom to access additional detailed analytics.
- Note: location accuracy may be affected by VPNs or other network settings.

Activity Feed

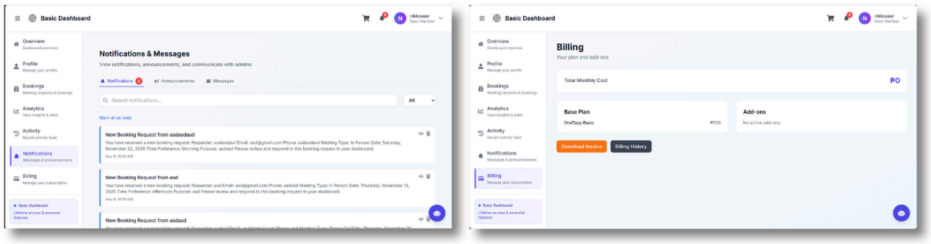


Purpose: The Activity section tracks all NFC card activities and interactions, providing a chronological log of card views, link clicks, meeting requests, and other engagement.

How to Use:

- Review summary statistics at the top: Total Activities (all-time count), Card Views (times your card was viewed), Link Clicks (clicks on your links), and Interactions (meeting requests and other actions).
- Filter activities: click All Activity, Card Views, Link Clicks, or Interactions to show only that type.
- Browse the Recent Activity list: each entry shows the action type (e.g., "Card viewed", "Meeting requested"), details (e.g., location, button clicked), and a timestamp (e.g., "9 hours ago", "1 day ago").
- Navigate pages: use the < Prev and Next > buttons, or click a page number to jump to that page.
- View details: click any activity entry to see more information about that interaction.

Billing & Notification

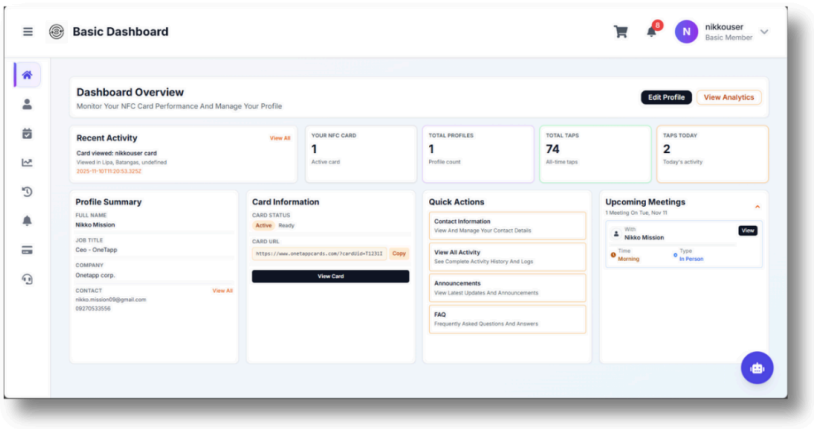


Purpose: The Billing section shows your current subscription plan, add-ons, and total monthly cost, and provides access to invoices and billing history. The Notifications section is a central hub for viewing system notifications, announcements, and messages from administrators, helping you stay informed about important updates and communications.

How to Use:

- Review your Total Monthly Cost at the top to see your current monthly subscription amount.
- Check the Base Plan card to see your active subscription plan and its monthly or one-time cost.
- Review the Add-ons card to see any additional features you've purchased and their costs.
- Click Download Invoice to generate and download a printable receipt of your current subscription.
- Click Billing History to view a complete list of all your past billing transactions, including purchase dates, amounts, and status.
- Notifications:
- Switch between tabs: click Notifications (shows unread count), Announcements, or Messages to view different types of communications.
- Search: use the Search notifications... bar to find specific items by title or content.
- Filter notifications: use the All, Unread, or Read dropdown to filter your notifications list.
- Manage notifications: click the eye icon to mark a notification as read, or the trash icon to delete it. Click Mark all as read to mark all unread notifications at once.
- View announcements: read system announcements with priority levels (high, medium, low) indicated by colored badges.
- Check messages: review messages from administrators, which show as "Read" or "Unread" status.

Client Dashboard (Overview)

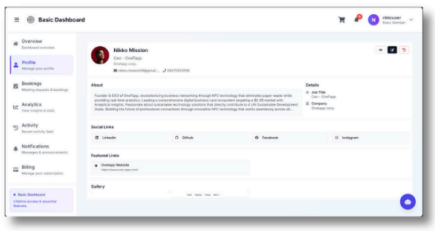


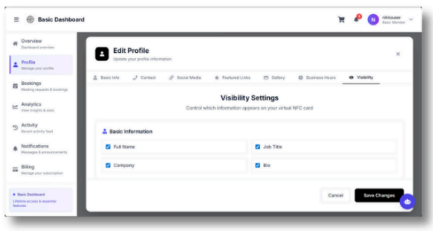
Purpose: Provide an at a glance view of the card owner's NFC card performance and quick entry points to manage their profile and activities.

How to Use:

- Review the KPI tiles at the top to see your current metrics: Your NFC Card (active card count), Total Profiles, Total Taps (all-time), and Taps Today.
- Check the Recent Activity card for the latest card views and taps; click View All to see the complete history.
- Use the Edit Profile button (top right) to update your information, or click View Analytics for detailed performance data.
- In the Card Information card, check your Card Status, copy your Card URL using the Copy button, or click View Card to see your live card.
- Use the Quick Actions card to access Contact Information, view All Activity, read Announcements, or open the FAQ.
- Review the Upcoming Meetings card for scheduled meetings and click View to see meeting details.

Profile





ACKNOWLEDGEMENT AND CLOSING NOTES

Developed By:

This system was design and develop by:

- Almario, Joshua S.
- Mission, Paul Nikko D.
- Panopio, Christian Mark E.

System Limitations and Disclaimer:

Disclaimer: The OneTapp platform is currently in active development. Some features may be incomplete, unavailable, or subject to change. Payment processing is in test mode only—do not use real money. We are working to complete these features and will notify users when updates are available.
Payment & Client-Side Limitations: The payment system is currently in a test/sandbox environment. Do not use real money, as real payment processing will be enabled in the future. On the Basic Dashboard:

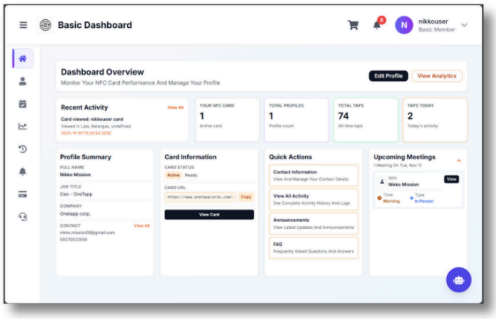
- Payment transactions use test credentials only; real payment processing is not yet active
- Advanced Data Export (multiple formats) is coming soon; basic export features are currently available
- The dashboard is not accessible on mobile devices (requires minimum 1024px screen width; desktop/tablet only)
- The Settings section is not accessible through the navigation menu
- Some support service endpoints may be temporarily unavailable

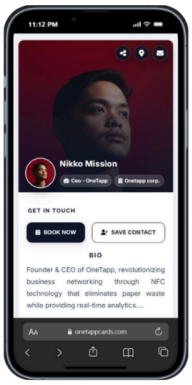
We are actively working on completing these features and will update you as they become available.

Contact for Further Support:

- For technical assistance, system updates, or inquiries, you may reach out to the development team listed above.
- Feel free to contact the team for:
- Resolving technical issues or troubleshooting system errors.
- Requesting new features or enhancements.
- Providing feedback for continuous improvement of the system.

SYSTEM OVERVIEW



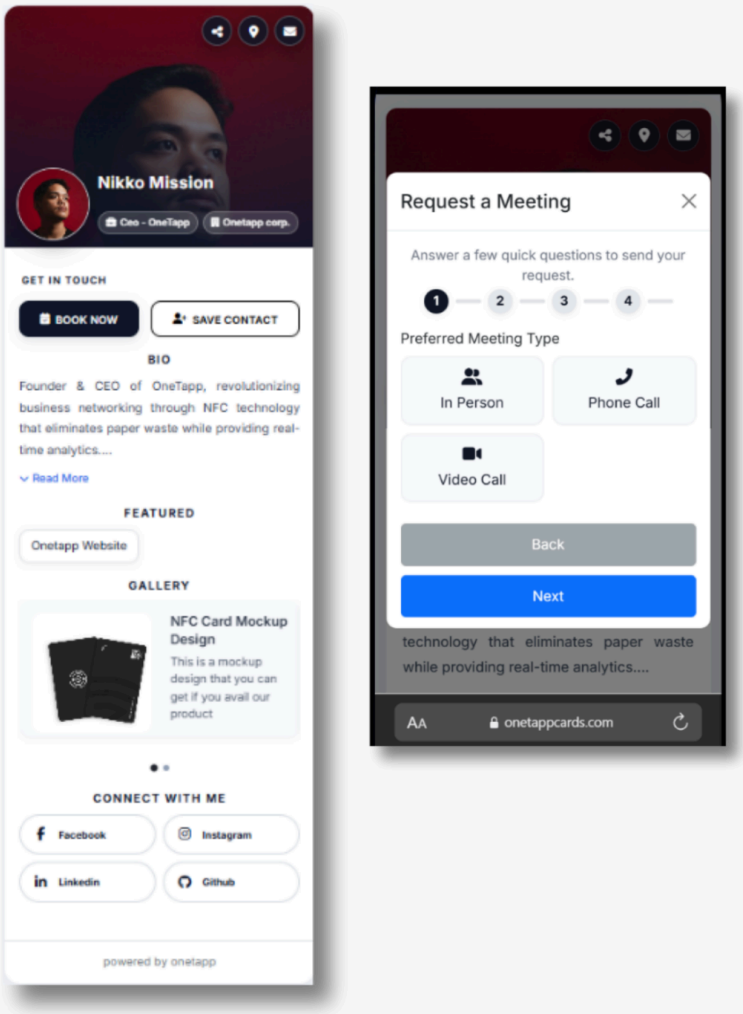


OneTapp is a virtual business card platform powered by NFC technology. It combines a web dashboard for card owners and NFC cards that recipients tap to view profiles. The Website & Virtual Business Card: The website gives owners a dashboard to update their profile, manage what gets shared, track engagement, and control multiple cards. The virtual business card is what recipients experience: a quick tap opens the owner's latest profile contact info, social links, media, and more without requiring an app. Changes made in the dashboard appear instantly on the card, so the card always reflects the current information.

USER ROLES

ROLE	PERMISSION
Admin (Developers)	Full system control. Manage user accounts, configure platform settings, deploy updates, monitor system health, troubleshoot issues, access all data and analytics, generate reports, approve or revert changes, and provide technical support to clients.
Client (Card Owner)	Manage their virtual business card. Create and edit profiles, choose what information appears on taps (contact details, social links, media), view engagement metrics and tap analytics, manage multiple cards, update content in real time, and control privacy settings.
End User (Card Tapper)	Access shared profiles by tapping NFC cards. View contact information, social links, media, and other content the card owner has chosen to share. No account or app required—just tap and view.

Virtual Business Card



Purpose: The virtual business card showcases the card owner's profile, roles, and OneTapp offerings in a single digital hub that visitors can access instantly via NFC or URL to connect and learn more.

How to Use:

- Tap the NFC card (or open the shared link) on a smartphone to load the profile.
- Review the quick actions—Book Now and Save Contact to schedule a meeting or store the card owner's details.
- Expand the bio with "Read More" for background information, open the featured link for company resources, and swipe through the gallery for product visuals.
- Choose any social button to follow or message the card owner on Facebook, Instagram, LinkedIn, or GitHub, and share the card's link for easy referrals.

D. Grammarian's Certification

Republic of the Philippines
BATANGAS STATE UNIVERSITY
The National Engineering University
Lipa Campus
A. Tanco Drive, Marawoy, Lipa City, Batangas, Philippines 4217
Tel. No. (043) 774-2526 / (043) 980-0387
Website Address: http://www.batstate-u.edu.ph

CERTIFICATION

This is to certify that the Capstone Project entitled **"Development of an Intelligent Business Card using NFC with Real-Time Engagement Analytics"**, authored by **Almario, Joshua S., Mission, Paul Nikko D.,** and **Panopio, Christian Mark E.** has been checked and edited by the undersigned.

It now follows the standard format of the University and the conventions of research writing.

FIL LAURENCE L. MAMATO, MAEd
Grammarian

Date signed: January 12, 2026

E. Turnitin Results

*% detected as AI

AI detection includes the possibility of false positives. Although some text in this submission is likely AI generated, scores below the 20% threshold are not surfaced because they have a higher likelihood of false positives.

Caution: Review required.

It is essential to understand the limitations of AI detection before making decisions about a student's work. We encourage you to learn more about Turnitin's AI detection capabilities before using the tool.

Disclaimer

Our AI writing assessment is designed to help educators identify text that might be prepared by a generative AI tool. Our AI writing assessment may not always be accurate (i.e., our AI models may produce either false positive results or false negative results), so it should not be used as the sole basis for adverse actions against a student. It takes further scrutiny and human judgment in conjunction with an organization's application of its specific academic policies to determine whether any academic misconduct has occurred.

Frequently Asked Questions

How should I interpret Turnitin's AI writing percentage and false positives?

The percentage shown in the AI writing report is the amount of qualifying text within the submission that Turnitin's AI writing detection model determines was either likely AI-generated text from a large-language model or likely AI-generated text that was likely revised using an AI paraphrase tool or word spinner.

False positives (incorrectly flagging human-written text as AI-generated) are a possibility in AI models.

AI detection scores under 20%, which we do not surface in new reports, have a higher likelihood of false positives. To reduce the likelihood of misinterpretation, no score or highlights are attributed and are indicated with an asterisk in the report (*%).

The AI writing percentage should not be the sole basis to determine whether misconduct has occurred. The reviewer/instructor should use the percentage as a means to start a formative conversation with their student and/or use it to examine the submitted assignment in accordance with their school's policies.

What does 'qualifying text' mean?

Our model only processes qualifying text in the form of long-form writing. Long-form writing means individual sentences contained in paragraphs that make up a longer piece of written work, such as an essay, a dissertation, or an article, etc. Qualifying text that has been determined to be likely AI-generated will be highlighted in cyan in the submission, and likely AI-generated and then likely AI-paraphrased will be highlighted purple.

Non-qualifying text, such as bullet points, annotated bibliographies, etc., will not be processed and can create disparity between the submission highlights and the percentage shown.

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  Matches with neither in-text citation nor quotation marks
- 3 Missing Quotations 0%
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  Matches that have quotation marks, but no in-text citation
- 0 Cited and Quoted 0%
  Matches with in-text citation present, but no quotation marks

Top Sources

2% Internet sources
1% Publications
5% Submitted works (Student Papers)

Integrity Flags

0 Integrity Flags for Review

Our system's algorithms look deeply at a document for any inconsistencies that would set it apart from a normal submission. If we notice something strange, we flag it for you to review.

A Flag is not necessarily an indicator of a problem. However, we'd recommend you focus your attention there for further review.

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Match Groups

- 91 Not Cited or Quoted 5%
  Matches with neither in-text citation nor quotation marks
- 3 Missing Quotations 0%
  Matches that are still very similar to source material
- 0 Missing Citation 0%
  Matches that have quotation marks, but no in-text citation
- 0 Cited and Quoted 0%
  Matches with in-text citation present, but no quotation marks

Top Sources

2% Internet sources
1% Publications
5% Submitted works (Student Papers)

Top Sources

The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

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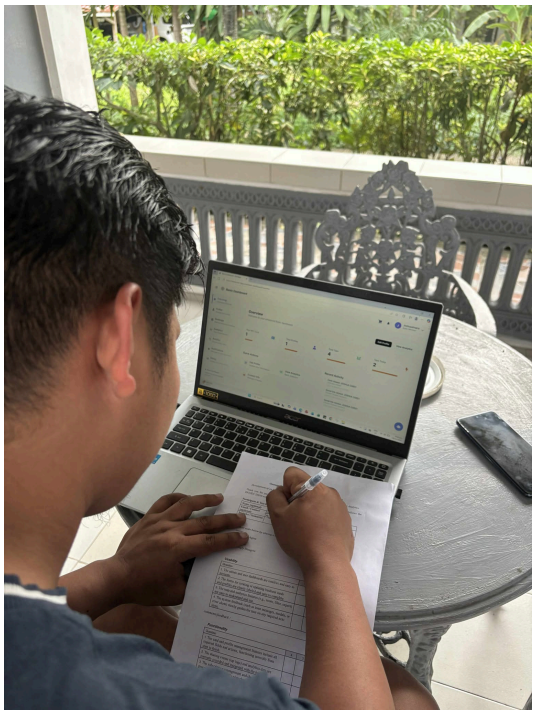
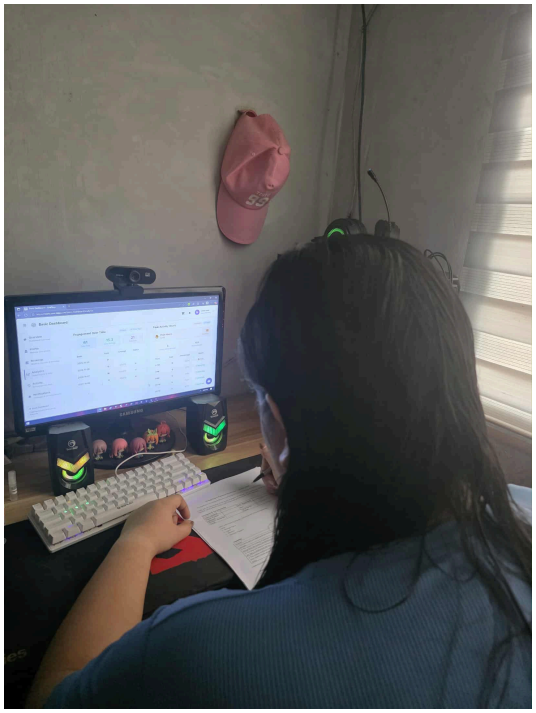
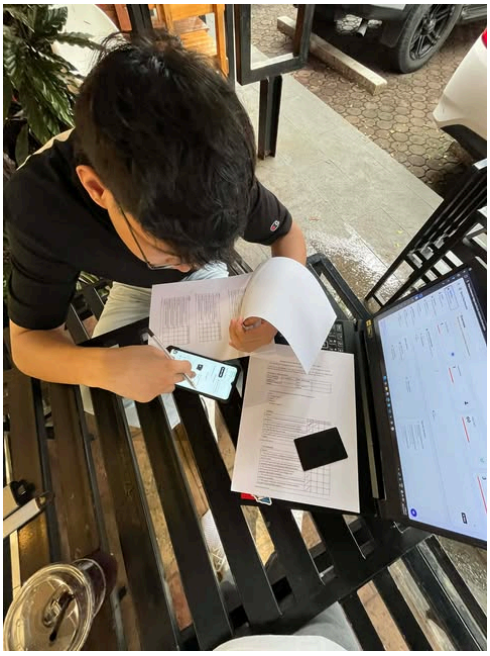
F. Proof of System Evaluation

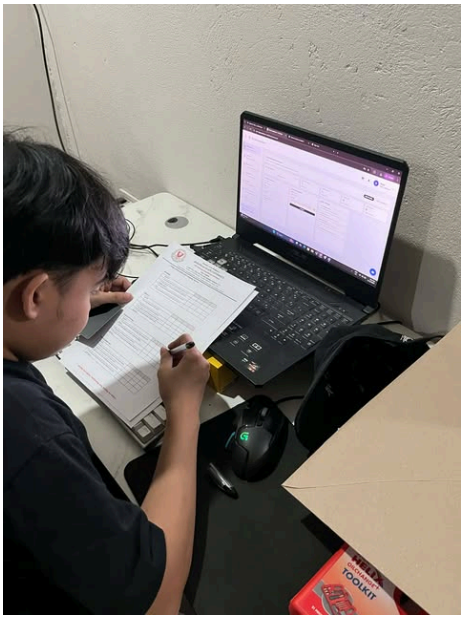
Expert Evaluation

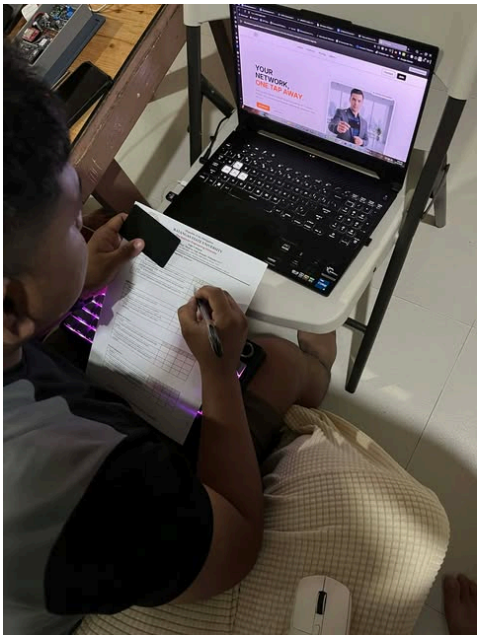


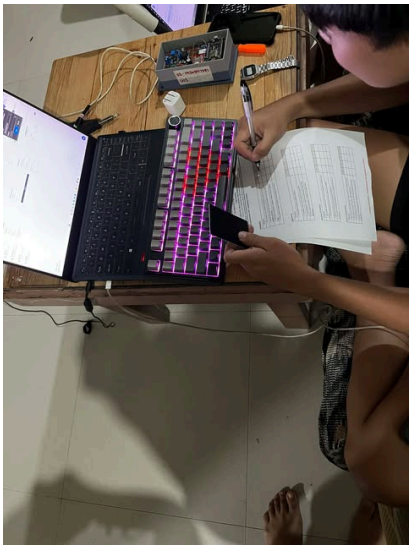


User Acceptance Evaluation









G. Curriculum Vitae

JOSHUA ALMARIO

SYSTEM DESIGNER AND SOFTWARE QUALITY ASSURANCE

09615751075
joshuaalmario10@gmail.com
Rosario, Batangas

ABOUT ME

Software Quality Assurance and System Designer from Batangas, Philippines, passionate about building reliable, efficient, and user-centered systems. I combine a keen eye for design with a strong foundation in testing and system analysis to ensure high-quality, well-structured solutions. Currently a 4th-year BS Information Technology student (Major in Business Analytics) at Batangas State University, I enjoy designing scalable systems, ensuring software reliability, and continuously improving development and testing processes through modern tools and best practices.

EDUCATION

2022 - 2026
Lipa City, Batangas

BATANGAS STATE UNIVERSITY - TNEU LIPA CAMPUS
Bachelor of Science in Information Technology Major in Business Analytics

2020 - 2022
Rosario, Batangas

Saint Joseph College
Science, Technology, Engineering, and Mathematics

ORGANIZATIONS

Lipa City, Batangas
August 2025 - July 2026

Tech Innovators Society
Member

SKILLS

Technical Skills: Software Testing, API Testing, QA Tools (Postman, Selenium, JMeter), CI/CD, System Design, UI/UX Design, HTML5, CSS3, JavaScript, React, Tailwind, PHP, Java, Python, Analytics.

Non-Technical Skills: Problem Solving, Communication, Teamwork, Time Management, Adaptability, Critical Thinking.

I hereby certify that the above information is true and correct to the best of my knowledge as of November 10, 2025.

Joshua S. Almario
Student

PAUL NIKKO MISSION

FULL STACK DEVELOPER

09270533556
nikko.mission09@gmail.com
Lipa, Batangas

ABOUT ME

Full-stack developer from Batangas, Philippines, passionate about building clean, fast, and reliable web applications. I combine a strong UI sense with solid backend fundamentals to deliver responsive interfaces, accessible design, and robust APIs. Currently a 4th-year BS Information Technology student (Major in Business Analytics) at Batangas State University, I enjoy shipping features end-to-end, optimizing performance, and learning modern tooling that helps teams move faster and ship better software.

EDUCATION

2022 - 2026 Lipa City, Batangas	**BATANGAS STATE UNIVERSITY - TNEU LIPA CAMPUS** Bachelor of Science in Information Technology Major in Business Analytics
2019 - 2021 Padre Garcia, Batangas	**Holy Trinity School of Padre Garcia** Science, Technology, Engineering, and Mathematics

ORGANIZATIONS

Lipa City, Batangas August 2025 - July 2026	**Tech Innovators Society** Member

SKILLS

Technical Skills:	JavaScript, TypeScript, Python, Java, PHP, HTML5, CSS3, React, Next.js, Redis, Tailwind CSS, Material-UI, Bootstrap, Sass, Framer Motion, Vite, API Testing, Performance Optimization, CI/CD Integration, Analytics
Non-Technical Skills:	Problem-Solving, Effective Communication (Written and Verbal), Teamwork & Collaboration, Time Management, Adaptability, Critical Thinking

I hereby certify that the above information is true and correct to the best of my knowledge as of November 10, 2025.

PAUL NIKKO D. MISSION
Student

BATANGAS STATE UNIVERSITY

The National Engineering University

Lipa Campus

College of Informatics and Computing Sciences

CHRISTIAN MARK PANOPIO

MOBILE AND
FULLSTACK DEVELOPER

09456027345

christiannnpanopio@gmail.com

Mataasnakahoy, Batangas

ABOUT ME

Mobile and Full Stack Developer from Batangas, Philippines, passionate about building seamless digital experiences through code and automation. I specialize in developing cross-platform applications, web systems, and automated workflows using modern tools and technologies. Currently pursuing a Bachelor of Science in Information Technology major in Information Assurance and Security at Batangas State University, I aim to merge innovation and efficiency in every project — from intuitive front-end design to robust back-end logic and workflow automation.

EDUCATION

2022 - 2026 Lipa City, Batangas	**BATANGAS STATE UNIVERSITY - TNEU LIPA CAMPUS** Bachelor of Science in Information Technology Major in Business Analytics
2020 - 2022 Lipa CIty, Batangas	**Batangas College Of Arts and Sciences** Science, Technology, Engineering, and Mathematics

ORGANIZATIONS

Lipa City, Batangas August 2025 - July 2026	**Tech Innovators Society** Member

SKILLS

Technical Skills:	Flutter/Dart, React Native, Javascript, HTML5, CSS3, Firebase, SQL, Git, React, next.js, PHP, Bootstrap, Python, Figma, API integrations, Software Testing, Express, Tailwind CSS, Webhooks
Non-Technical Skills:	Problem Solving, Team Collaboration, Communication, Adaptability, Creativity, Time Management, Critical Thinking

I hereby certify that the above information is true and correct to the best of my knowledge as of November 10, 2025.

Christian Mark E. Panopio
Student