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Title: Co-Designing a Community Voucher Digital Wallet: The Case of the Kroon Voucher

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Category	Min	Max	Chosen
Requirement Analysis and Design	0	20	10
Theoretical Analysis	0	25	0
Experiment Design and Execution	0	20	10
System Development and Implementation	0	20	10
Results, Findings and Conclusions	10	20	15
Aim Formulation and Background Work	10	15	15
Quality of Paper Writing and Presentation	10		10
Quality of Deliverables	10		10
Overall General Project Evaluation (*this section allowed only with motivation letter from supervisor*)	0	10	
Total marks		**80**	

Co-Designing a Community Voucher Digital Wallet: The Case of the Kroon Voucher

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Abstract

This paper explores the functional and design requirements for the "Kroon" community voucher digital wallet, co-designed with the Ocean View community and integrated into the iNethi app. Through a co-design process involving three workshops and 20 community members,the research identified key user preferences, with participants prioritizing features focused on core financial transactions tailored to the local economic context. Features like "Earn Kroon" and "Internet Voucher Top-Up" were seen as better integrated into the broader iNethi app, reflecting the community's preference for a simpler, more focused wallet design. The research revealed that extensive security features were not a priority for the community, as the wallet was not perceived as being tied to critical financial activities. These findings highlight the importance of community-driven design and the need to align financial tools with user priorities and local contexts.

Keywords: Community Currency,Co-design process, Digital Wallet, Mobile banking

1 Introduction

Financial exclusion remains a persistent challenge in South Africa, where significant segments of the population are unable to access the formal financial system. This exclusion often stems from the inability of low-income earners, micro-entrepreneurs, and marginalized communities to meet the stringent requirements imposed by traditional banking institutions[30, 37]. Despite the theoretical inclusiveness of South Africa's banking system, barriers such as high costs, physical distance from financial institutions, and inadequate documentation continue to limit access to essential financial services[8].

In response to these challenges, mobile banking has emerged as a critical tool in bridging the gap, offering greater accessibility and convenience for underserved populations. However, mobile banking alone cannot fully address the unique needs of the unbanked, particularly in communities where traditional financial services remain out of reach[35, 40]. This has led to the exploration of alternative financial systems, such as community currencies and voucher-based solutions, which enable individuals to participate in local economies without relying on conventional banking structures[5, 6, 28].

This research focuses on the development of a community-based voucher wallet, named "Kroon," designed specifically for the Ocean View community in South Africa. Using a collaborative co-design process involving local residents, this research aims to create a secure, efficient, and user-friendly community voucher digital wallet for facilitating voucher-based transactions.

The research focuses on understanding the unique needs of this unbanked community and how these inform the design of the wallet's user interface (UI) and functionality. By integrating local insights into the design process, the research aims to create a solution that is accessible, secure, and easy to use for the intended users. While the project contributes to the broader discourse on innovative approaches to financial inclusion, its primary focus is on gathering the functional requirements and developing an intuitive and effective UI that enhances the user experience for the intended audience.Additionally, the research seeks to understand how security is perceived by the community members and explore how security features can be effectively incorporated into the application based on the community's priorities and local use cases.

This research highlights the role of participatory design in creating digital financial tools that reflect the realities of the communities they are meant to serve, ensuring both usability and relevance to the local context.

2 Background

One of iNethi's deployments is located in Ocean View, Western Cape, South Africa. The Ocean View Community Wireless Network (OVCWN) is a community-owned mesh wireless network that currently operates 20 hotspots, accessible to anyone within their coverage area. This network allows residents to access local resources and the internet at affordable rates by sharing a collective connection[25]. Community members can purchase vouchers for R20 per gigabyte, offering significant savings compared to the lowest-priced 1GB vouchers from mobile operators in South Africa[25, 45].

Local content services in Ocean View have seen limited use compared to external services. Between December 2019

and May 2020, while total internet traffic reached 203 GB, local services accounted for just 1.8 GB. This underutilization is believed to result from local services primarily being discovered through word of mouth rather than the voucher interface. The design of the interface and a general lack of awareness are believed to contribute to the significantly lower usage of local content and services[12].

To address this issue, an application is being developed that consolidates all of iNethi's content services into a single, user-friendly platform. This application aims to boost engagement by providing users with easy access to all local content and services on a unified page. The app will feature tools for managing connectivity, including checking internet voucher balances, and will display the uptime and availability of local WiFi access points. Additionally, the application will support a community-based digital voucher system known as the Kroon wallet, which is an entirely new feature designed to facilitate local transactions and encourage community-driven economic participation.

While the Kroon wallet is integrated into the iNethi app, it is not a consolidation of existing iNethi services but rather an addition that enhances the range of offerings available to users. An app store will also be introduced, allowing users to download various applications and further enrich the local content ecosystem. The impact of these initiatives on user engagement and local content usage will need to be assessed over time. *Appendix Section A* shows how the Kroon wallet relates to the iNethi App.

3 Literature Review

3.1 Financial Exclusion

Financial exclusion, defined as the inability of certain societal groups to access formal financial systems, remains a significant issue in South Africa and across Africa [44].Only 38 percent of adult males and 27 percent of adult females in sub-Saharan Africa had accounts at formal financial institutions, highlighting the widespread lack of access to affordable and secure financial services [2]. In South Africa, this exclusion is historically rooted in apartheid, where financial services were largely restricted to the non-black community until 1994 [21]. Although the apartheid era has ended, financial exclusion persists, with commercial banks often avoiding low-income earners, micro-entrepreneurs, and the poor due to high service costs [37].

Financial inclusion is more prevalent among those with higher purchasing power, education, and stable employment, particularly older, wealthier men in urban areas. These trends are consistent within Africa and globally, underscoring the multifaceted nature of financial exclusion [30]. Financial inclusion improves welfare by reducing poverty, empowering women, and fostering economic growth, yet barriers such as

high account costs and inadequate documentation remain significant [1, 30].

3.2 Tools to Combat Financial Exclusion

Mobile banking and community currencies have become effective tools in addressing financial exclusion, particularly in developing countries like South Africa [2, 6, 13].

3.2.1 Mobile Banking Mobile banking (M-banking) refers to the use of mobile devices, such as smartphones, to perform banking transactions and access financial services [23, 40, 47]. It offers users the flexibility to manage their accounts anytime and anywhere, particularly in remote areas with network connectivity.

The widespread adoption of mobile devices has fueled the growth of mobile banking, enabling personalized experiences and extending the reach of banks, especially to unbanked populations [40]. Mobile banking enhances customer experience by providing 24/7 access, improves operational efficiency by reducing wait times, and adds value for consumers through personalized services. Advancements in mobile technology have significantly expanded the range of available banking services. Mobile banking functionalities are generally categorized into three main groups [41]. The first category, state-changing functions, includes activities that directly impact account balances, such as money transfers. The second category, private view functions, provides access to confidential information, including account balances. Lastly, customized view functions offer tailored public information, such as personalized news and ATM locations. These categories together form the core of modern mobile banking capabilities.

Most banks offer a basic mobile banking solution that includes services such as account alerts, balance updates, customer support, bill payments, and funds transfers. [23, 35, 40, 41, 47].

3.2.2 Digital Wallets Digital wallets are virtual storage systems that securely manage a user's identity and digital credentials, enabling safe electronic transactions. These wallets use software to encrypt and protect sensitive information, making them essential for secure online financial activities [39].

Cryptocurrency wallets, a specialized form of digital wallets, store the private and public keys necessary for blockchain transactions [9]. These wallets allow users to securely manage digital currencies, utilizing advanced cryptographic techniques to safeguard access to their assets. Cryptocurrency wallets can be divided into two main types: software wallets and hardware wallets, each offering different levels of security and convenience [19, 39].

Software wallets can be further categorized into hot wallets and cold wallets. Hot wallets are connected to the internet, offering greater convenience, but with potentially lower security. In contrast, cold wallets are kept offline, providing enhanced security at the cost of reduced convenience. Hardware wallets, on the other hand, are physical devices that store keys offline. By keeping the keys away from online threats, they offer a high level of security [17, 19].

Security remains a critical concern, especially in key recovery and management. The loss of keys or passwords can result in the permanent loss of funds, making recovery methods such as seed phrases vital. Hardware wallets, which store cryptocurrency data offline, are particularly secure, while paper wallets provide an entirely offline method for managing digital assets [31, 42].

3.2.3 Community Currencies and Vouchers
Complementary currencies, also known as social or local currencies, are forms of Community Currencies (CCs) that operate alongside conventional money to combat social exclusion and promote local development by enhancing financial inclusion. These currencies circulate within specific regions or communities, facilitating the exchange of goods and services without accruing interest [5, 10, 13, 24, 27].

Economic sustainability is centered on providing equal economic opportunities to all individuals, regardless of socioeconomic status [20]. Community currencies strive to achieve this by creating avenues for economic participation, especially for marginalized groups [38]. By keeping resources within the community, they bolster local economic resilience, support local businesses, and recognize informal work and skills often overlooked by the formal economy [32].

Advocates argue that community currencies contribute to economic sustainability by encouraging localization and stimulating local economic activity. These currencies facilitate faster and broader circulation of money within the community, enhancing the local economic multiplier and increasing local incomes [20]. Community currencies are diverse in their design and objectives, ranging from physical paper-based currencies to digital systems, with varying scales and intended outcomes [16, 33].

3.2.4 Sarafu-Credit Voucher System
A notable example is the Sarafu-Credit voucher system implemented by Grassroots Economics (GE) in Kenya. Since 2015, GE has deployed Community Inclusion Currencies (CICs) to support local economic development, particularly in marginalized, food-insecure areas. The Sarafu system, unified into a single CIC called "Sarafu" in 2020, had over 55,000 registered accounts and facilitated transactions worth 2.8 million USD by the end of 2021 [7, 22]. Sarafu-Credit vouchers are distributed through zero-interest loans for one year, supplementing the national currency and enabling trade even when the national

currency is scarce. This system enhances food security and economic resilience in vulnerable communities [6, 26].

Sarafu operates through a USSD (Unstructured Supplementary Service Data) interface, allowing users to interact with the system without internet connectivity, making digital CICs accessible to a broad portion of the Kenyan population [6, 7]. Research suggests that community currencies like Sarafu have significant potential to promote sustainable development, support social and solidarity economies, and reduce poverty in informal settlements. Scholars propose that CCs could serve as effective policy instruments in social welfare, environmental, and economic programs, highlighting their role in addressing food security and economic challenges in vulnerable communities [3, 26].

3.3 Security

Security, privacy, trust, and risk are critical concerns in the adoption of mobile banking, particularly due to the lack of face-to-face interaction and the handling of sensitive personal information. To address these challenges, financial institutions have prioritized security by employing various authentication techniques to protect transactions and customer data[34].

Common methods include the use of strong passwords, one-time passwords (OTPs), and increasingly, biometric identification such as fingerprint and facial recognition. Two-factor authentication (2FA), which combines passwords with an additional security factor, further strengthens account security. Additional options like USB security keys and voiceprint authentication provide extra layers of protection, making it more difficult for unauthorized users to gain access[15].

To stay ahead of emerging threats, banks continuously update their security measures and educate customers on fraud prevention. Biometric authentication, which uses physical or behavioral traits for identification, has become a reliable and cost-effective security solution, particularly with the widespread integration of fingerprint sensors in mobile devices. However, challenges such as physical contact requirements, cultural resistance, and privacy concerns need to be addressed to ensure the widespread acceptance of these technologies[34].

Overall, advancements in biometric systems have significantly enhanced the security of mobile transactions, offering a more robust alternative to traditional security measures. These innovations help mitigate risks, foster trust, and ensure privacy, making mobile banking a safer and more secure option for consumers[36].

4 Experimement Design

4.1 Research Objectives

The primary goal of this research is to use a co-design approach to develop a community voucher digital wallet, called the "Kroon," in collaboration with the community members of Ocean View. The aim is to create an application that allows community members to send and receive Kroons within their local context, with a focus on developing a user interface (UI) that is intuitive, user-friendly, and tailored to the specific needs of the community. Additionally, the research seeks to understand how security is perceived by the community members and explore how security features can be effectively incorporated into the application based on the community's priorities and local use cases.

4.2 Research Questions

This research seeks to address two main questions: First, what are the key functional use case requirements and design preferences for the Kroon community voucher digital wallet, and how do they align with the needs and priorities of the Ocean View community? Second, what are the key security concerns for users of the Kroon wallet, and how can these concerns be addressed in the design and implementation of the application?

4.3 Co-Design Methodology

In this study, a co-design research approach was adopted, involving 20 community members throughout the process via three workshops. This approach was chosen to gain a deeper understanding of the community's context and needs, ensuring that the final product accurately reflects their specific challenges and cultural nuances. By engaging community members directly in both the research and design phases, co-design empowered them to voice their needs and preferences, resulting in more relevant, sustainable, and user-centered solutions, particularly for marginalized groups. Community members were involved at every stage of the project making them active contributors rather than passive participants. This continuous involvement fostered a sense of ownership, increasing the likelihood that the final product would be embraced and supported by its intended users [11, 29, 46].

4.4 Participant Selection and Recruitment

Purposive sampling was employed to select participants based on characteristics relevant to the research objectives, focusing on individuals from the Ocean View community who could provide meaningful insights. Recruitment was facilitated by a key community member and business owner, who identified suitable participants and distributed posters and messages via WhatsApp. The selection criteria included being over 18 years old, owning a mobile phone (preferably Android), and residing in the Ocean View community. Efforts were made to balance male and female participants, and those familiar with the Focus network were preferred to ensure relevance and depth in feedback. This approach ensured the engagement of participants who could best contribute to the development of the digital wallet, aligning the research with the community's needs.

4.5 Data Collection

4.5.1 Initial Stakeholder Engagement
The initial phase of requirement gathering and data collection involved key stakeholders, particularly the Director of iNethi and a local business owner from Ocean View. Due to a delayed ethics approval process, the early stages of the project relied heavily on the input from these individuals to establish a basic framework for the community voucher digital wallet. Their contributions were crucial in identifying some of the fundamental needs and preferences likely to be relevant to the broader community. This early engagement provided a foundational understanding that guided the initial design and helped shape the app in preparation for more direct community involvement.

4.5.2 Community Workshops
The primary method of data collection was a series of community workshops. These workshops were designed to facilitate direct engagement with community members, ensuring that their voices and insights were central to the app's development. Through this participatory process, in-depth feedback was gathered, allowing for iterative refinement of the app's features and functionality. Ethical considerations were prioritized throughout the process, ensuring that participants were fully informed and comfortable with their involvement. The artifacts collected during the workshops are detailed in *Appendix Sections D* and *E*, respectively.

4.5.3 Workshop 1: Understanding Community Needs and Context
Date: 9 August

The first workshop aimed to gain a comprehensive understanding of the community's financial practices, the challenges they face in accessing financial services, and their expectations for a digital wallet. To achieve this, a focus group discussion was organized, involving community members from diverse backgrounds. During these discussions, participants shared insights into their daily financial practices, the obstacles they encounter, and their expectations for a digital wallet. An initial prototype of the digital wallet concept was presented to help participants visualize the app and discuss how they would prefer to use it. Additionally, the user flow was collaboratively designed, mapping out the steps participants wanted to follow when using the wallet to ensure that it was intuitive and aligned with their needs.

The outcomes of this workshop included a comprehensive understanding of the community's financial needs and expectations, which provided essential context for the development of the digital wallet. Additionally, the workshop led to the creation of an initial user flow that was designed with direct input from the community, ensuring that the app would be intuitive and aligned with their needs. Furthermore, the discussions yielded valuable insights into the community's financial habits and the specific pain points they experience, which would be crucial in refining the app's features to better serve its users.

4.5.4 Workshop 2: Feature Ranking and Prioritization
Date: 13 August

The second workshop focused on delving deeper into the specific features of the digital wallet, with an emphasis on understanding which features were most important to the community. During this session, participants engaged in a feature ranking exercise, prioritizing different aspects of the digital wallet, such as security, usability, and functionality. An updated prototype, which incorporated feedback from the first workshop, was also presented. This allowed participants to see the impact of their input and provide further feedback.The outcomes of this workshop included a prioritized list of features, informed by insights into community preferences, as well as an enhanced understanding of community concerns, particularly regarding security and usability.

4.5.5 Workshop 3: App Testing, Usage Tracking, and Final Feedback Date: 20 August

The final workshop focused on testing the latest version of the digital wallet, allowing community members to download and interact with the app in real time. Prior to downloading the app, informed consent was obtained from participants, with an additional disclosure about usage tracking. It was explained that app usage would be monitored to gather insights into how participants interacted with the app, which would be used to refine its features.

During the workshop, cognitive walkthroughs were conducted with participants. A set of pre-prepared tasks, detailed in Appendix Section F, was given to each participant, designed to evaluate the app's core functionality and usability. Observations were made as participants completed these tasks, noting any challenges or issues they encountered. Following the cognitive walkthroughs, participants were encouraged to continue interacting with the app while usage patterns were tracked. A feedback session was then held immediately after the cognitive walkthroughs, where participants shared their experiences, discussed any difficulties encountered, and suggested improvements.

The outcomes of this workshop included confirmation that the app's functionality aligned with community needs.

These insights informed the identification of final adjustments based on both user feedback and observed usage patterns.

4.6 Data Analysis

Data was collected through audio recordings, photographs of artifacts created during the workshops, and field notes. In the days following each workshop, these materials were thoroughly reviewed to deepen the understanding of the data. Immediately after each session, key insights and notable points were recorded to ensure no important details were overlooked. Key events were summarized, and standout moments were highlighted. In the subsequent days, the material was revisited for more detailed analysis and reflection.

During the analysis phase, thematic analysis was employed to code the data and identify emerging themes. The analysis was conducted informally, and while it allowed for the identification of key themes, it lacked the depth and rigor typically associated with formal thematic analysis. One limitation of this approach is that the informal nature of the analysis may have affected the thoroughness and reliability of the findings. Additionally, potential biases or gaps in interpretation may have emerged due to the less structured nature of the analysis process.

Despite these limitations, several key themes emerged from the data, such as a preference for core features, community incentives and exchange, and onboarding and user guidance. Participants preferred basic functionalities like balance tracking and money transfers, showing little interest in advanced features, suggesting simplicity should be prioritized in the wallet's design. Regarding community incentives and exchange, participants felt these services should not be part of the wallet itself but integrated into the broader iNethi app, with the wallet remaining focused solely on financial transactions. Finally, onboarding was a key challenge. Participants faced difficulties with SMS authentication and security verification, often requiring in-person help. However, once onboarded, they found the apps easy to use, underscoring the need for a clear, user-friendly onboarding process with in-app tutorials for those with limited digital literacy.

4.7 Data Validation

To ensure the validity and accuracy of the workshop findings, the researcher employed a rigorous data validation process, including detailed summaries and thematic analysis after each session. These findings were revisited at the start of the next workshop, where participants were asked to confirm or clarify the conclusions, ensuring they accurately reflected their views.

The researcher consistently referenced prior discussions, prompting participants to confirm or amend their statements,

thus enhancing data reliability. Additionally, an external observer took notes during the first workshop, providing a secondary perspective for cross-verifying the findings and reducing personal bias. This multi-layered validation process ensured that the final conclusions were credible and reflective of the participants' true intentions.

4.8 Data Quality

To ensure high-quality data collection during the workshops, practice sessions were conducted to refine facilitation techniques and address potential communication or management issues. These sessions improved the structure of the workshops, enhancing clarity and consistency. A comprehensive workshop protocol was developed, outlining discussion points, time management, and data collection methods. The protocol was iteratively refined based on supervisor feedback, ensuring alignment with research objectives and effective participant engagement.

5 Ethical Considerations

In conducting this research, strict adherence to the ethical codes and policies established for research was maintained. Honesty and integrity were prioritized, ensuring that no information was fabricated, falsified, or misrepresented at any stage of the research.

Given that the participants were from a low-income area, extra measures were taken to protect them from potential exploitation or harm. To ensure that participation was not motivated solely by financial incentives, an honorarium of 100 rand, reflecting a typical daily wage, was provided—avoiding an excessive sum that could encourage participants to take unnecessary risks. Additionally, lunch was provided during the workshops to acknowledge their time and contribution without imposing undue influence.

Throughout the research, ethical guidelines prescribed by the research ethics framework were diligently followed. Ethics clearance was obtained from the UCT Faculty of Science Research Ethics Committee, which involved a thorough review of the engagement plans with participants to ensure compliance with established protocols and guidelines.

These ethical standards were consistently upheld throughout the research, maintaining the integrity of the research and respecting the rights and welfare of the participants.

5.1 Intellectual Property

This project, in collaboration with iNethi, follows the same licensing model as iNethi, adhering to the GNU General Public License (GPL) version 3. By aligning with this license, the project ensures that all software remains free and open-source, allowing anyone to use, modify, and distribute it. This promotes community-driven innovation while preventing proprietary restrictions, fully supporting the values of open access and shared development.

Furthermore, as the project hopes to contribute its work to iNethi, it continues to adhere to the licensing principles used within the collaboration. This means any content created by contributors is owned by the creators and is encouraged to be licensed under Creative Commons, facilitating open access and sharing within the community. This approach is crucial to iNethi's mission of building sustainable, locally-managed digital resources and services, and this project is committed to supporting that vision through open licensing.

6 System Development and Implementation

6.1 Project Management

In this project, the Agile methodology was employed to manage development efficiently and iteratively. Agile's core principles, such as flexibility and constant feedback, aligned well with the needs of continuous development and co-design. The work was structured into three-week-long sprints, ensuring that each sprint resulted in tangible progress that could be tested and reviewed during the workshops.

Communication played a crucial role in ensuring the smooth running of the project. WhatsApp was used for quick updates and direct communication within the team, while Microsoft Teams served as the central hub for documentation, meeting notes, and more formal discussions. This approach helped maintain a steady flow of communication, regardless of the individual tasks being worked on.

One identified risk was the challenge of developing multiple functionalities simultaneously within a single app. To address this, regular integrations were performed after each sprint. At the end of each sprint, all team members' work was integrated, followed by comprehensive testing to ensure the app functioned as expected.

6.2 Technology Stack

The front end of the application was developed using React Native, a versatile framework that enables cross-platform development for both Android and iOS platforms. This choice allowed us to maximize the app's reach without the need for separate codebases, ensuring a consistent and seamless experience for users across different devices. React Native's flexibility also streamlined the development process, enabling faster iteration cycles and the easy integration of user feedback.

The decision to use React Native was motivated by the need to cater to the diverse mobile platforms used within the Oceanview community. By opting for a cross-platform solution, the development team ensured that users, regardless

of their device, would enjoy a high-quality and consistent experience. Additionally, React Native's extensive libraries and support from a large, active community were invaluable for ongoing maintenance and updates.

6.3 Existing Code and Extension

The development process started with a basic, rudimentary version of the iNethi app, which served as a foundation for further enhancements. The primary focus was on improving and extending the existing features of the app, particularly the digital wallet. While the community voucher digital wallet service was already present in the system, it was in a basic form and not fully developed, requiring significant refinement to meet the needs of the users. The basic version of the app is shown in *Appendix Section C*.

The app's architecture was designed to support multiple services, each functioning independently while being integrated into the larger iNethi ecosystem. The primary responsibility was to design and implement the user interface (UI) of the digital wallet, ensuring it was intuitive, user-friendly, and aligned with the needs of the community it was developed for.

Although the back-end infrastructure, responsible for providing the necessary API endpoints, was outside of direct responsibility, its solid functionality enabled the front-end team to focus entirely on improving the user interface. This clear division of responsibilities contributed to the development of a robust, modular, and scalable system.

6.4 Version Control

For version control, GitHub was used, following a GitFlow strategy to keep the development process organized and minimize conflicts between team members' contributions. Each team member worked on their own feature branch, and at the end of each sprint, all branches were merged into a central integration branch. This approach allowed for independent work while ensuring stable integration at regular intervals.

A separate branch was also created for each version of the app released for user testing. This strategy allowed for the isolation of these iterations, ensuring a clean point of reversion in case any issues arose during testing. By implementing this approach, development could continue uninterrupted while preserving the tested version of the app, providing a clear rollback option if necessary.

6.5 System Design

The system design was a key focus, particularly because the project may be taken over by other developers in the future. With this in mind, efforts were made to ensure the codebase

is clean, modular, and well-structured, allowing future developers to easily understand the architecture and onboard with minimal difficulty. By utilizing React and its extensive ecosystem of libraries, the project was also designed to benefit from the ample community support available, ensuring that any new developers can access resources and guidance when needed.

The front-end system design employs a flat architecture to organize the various components of the application, ensuring simplicity and scalability. Key directories include `API`, `routes`, `contexts`, `utilities`, and `components`, all of which are structured to keep functionality separated and easily accessible. The component-based design allows for reusable elements like the app header, while global state management is achieved through React's Context API, with the balance being a key example used across the home screen and wallet.The wallet's flat architecture is shown in *Appendix Section B*.

7 Findings and Results

Participants are anonymized as P1, P2, P3, etc., to protect their identities while presenting their perspectives. This approach ensures confidentiality while maintaining the integrity of the data.

7.1 Persistence of Financial Exclusion

Despite the perception that financial exclusion is diminishing, the workshops revealed that this issue remains prevalent, particularly among certain segments of the community. While most participants had access to bank accounts, some were still excluded from the formal financial system, primarily due to unemployment. These individuals often relied on their spouse's accounts for financial services, underscoring a persistent form of financial exclusion among economically disadvantaged groups. As P1 explained, *"No, I don't have a bank account, but my husband does, and I use his. We use it together."*

The issue of financial exclusion is further exacerbated by infrastructural challenges in marginalized communities. Participants frequently cited limited access to financial services, particularly ATMs. In some areas, only one ATM was available and operational only during specific hours, forcing individuals to travel to distant locations to access financial services. As P2 and P3 mentioned, *"Yes, the ATM closes at 5 at the butchery, and then we have to go to the mall and take an Uber to get there."* This finding underscores the persistent infrastructural deficiencies contributing to financial exclusion in marginalized areas.

7.2 Adoption and Use of Mobile Banking Apps

Contrary to initial expectations, participants generally reported positive experiences with mobile banking apps, finding them convenient, efficient, and user-friendly once onboarded. This feedback suggests that mobile banking apps are effectively designed to meet user needs. As P4 stated, *"Sending money via the mobile banking app is so much easier, because then I can just get a 'send money,' and I don't have to go to Eester River for 100 rand."*

However, the primary challenge identified was during the initial sign-up process, particularly for at-home registration. The verification process was a significant hurdle, often requiring participants to visit their banks for assistance. As P5 mentioned, *"Yeah, sometimes I struggle with that thing when you have to start the app and you have to take a picture. Yes, that gave me so much trouble. I had to go to the bank and get that lady to help me. Then they helped me there at the bank."* Once guided through the app setup at the bank, participants found the apps much easier to use, indicating a need for improved onboarding processes.

Participants also noted that banks are increasingly proactive in promoting mobile banking apps, with staff providing hands-on assistance during in-person visits. This support significantly improved the adoption process. As P5 further explained, *"Yes, the ladies at the bank actually do help me. When you go to the bank, and you have to go with your phone, because then they download the app for you, and they help you download the app."* Following this assistance, participants reported that the apps were highly convenient and beneficial for financial management.

7.3 Security Perceptions

Participants generally expressed minimal concern about the security of mobile banking and the digital community voucher digital wallet. The wallet, embedded within the iNethi app, was perceived as secure due to the initial login required to access the app. Additional security measures, such as separate logins for the wallet, were not deemed necessary by most participants. As P3 remarked, *"No, but I don't see why I'd have to, we need to have a password to the app, to the digital wallet, to the Kroon. It's not like someone's gonna steal the Kroon, man, you see?"*

However, participants preferred additional security measures, such as password prompts, only when performing transactions involving vouchers or tokens. This preference indicates trust in the overall system's security, with a desire for extra safeguards during sensitive transactions. As P6 suggested, *"What we can do is, you just require a password when you're about to send the money. So if you want to send anything, that's when we must have a PIN for security."*

The relaxed attitude toward security appears linked to the perceived low risk associated with the digital community voucher digital wallet, as it is not connected to broader financial data. Participants felt that the potential for significant loss was minimal, leading to a lower prioritization of stringent security measures. As P4 expressed, *"No, I don't think it matters what type of password is needed, but patterns are too easy, and a person can't see what you wrote. But you can make us choose a four-digit PIN."* This finding suggests that security concerns are closely tied to perceived risk, influencing user attitudes toward security in digital financial tools.

7.4 Technical Reliability and Data Management

Participants highly valued technical reliability and data management features, particularly regarding password recovery and data usage. Password recovery ranked as the top priority, with a strong preference for familiar methods such as Gmail or SMS-based recovery options. This reflects concerns about forgetting login details and highlights the importance of easy access and usability. Additionally, the need for a "Low Data Usage Mode" was the second most important feature, emphasizing the requirement for the app to function efficiently in low-data environments or even offline. As P5 commented, *"'Do I need to have data to use this wallet, this app?' I think it would be better if I could use it even if I'm not by the hotspot because the hotspots are quite far from where we live."* Given the high cost of data in the community, participants placed great importance on minimizing data usage.

When discussing security features, participants generally preferred a PIN over a pattern for unlocking the wallet, expressing concerns about the ease of observing a pattern. As P2 noted, *"A pattern is too easy, and a person can actually see what pattern you draw if they look at the screen. It's better we still have a PIN, then a person can choose just numbers, if they want numbers, or if they want numbers and words."* These findings suggest that technical reliability, offline functionality, and accessible password recovery mechanisms are crucial to ensuring the app's success, particularly in a community where internet connectivity and data affordability are significant concerns.

7.5 Focus on Simplicity and Separation of Transactional Features

A key insight from the workshops was participants' strong preference for simplicity and a clear distinction between transactional and non-transactional features. While they appreciated core functionalities like balance tracking and money transfers, there was little interest in advanced tools or additional features beyond these basic services. Participants emphasized the need for the Kroon digital wallet to remain straightforward and focused solely on financial transactions. Specifically, they felt that features like "Earn Kroon" and "Internet Voucher Top-Up" should be integrated into the larger iNethi app, not the wallet. As P8 remarked, *"No, that*

must be outside the wallet. That's like a job to earn the kroon, and the wallet must only have wallet stuff." This preference for segmentation suggests that participants view the wallet as a dedicated financial tool, with other community-based features residing within the broader iNethi ecosystem. By keeping the wallet focused on essential financial tasks and excluding non-transactional features, the app is more likely to remain user-friendly and meet the community's need for a streamlined, effective tool for managing Kroon.

7.6 Feedback on App Usability and Design

7.6.1 Onboarding Confusion A significant insight from Workshop 3 was the challenges participants faced during the onboarding process, particularly in creating an account before accessing the wallet. Many first-time users were unclear about what details were required for the sign-up, which led to confusion and frustration. This highlights that the onboarding process is a key pain point, requiring clearer guidance and instructions for new users. To ensure a smoother experience, the onboarding flow should emphasize account creation and provide clear instructions on the required information. This will help alleviate confusion and improve user satisfaction from the initial interaction with the app.

7.7 Understanding User Flow

Once participants successfully completed the sign-up process, they found navigating the app straightforward and intuitive. Participants were able to access the community voucher wallet without any significant issues or questions regarding its functionality. They easily performed tasks such as managing vouchers and navigating between sections of the app. This suggests that the core functionality and user flow of the app are well-designed and effective. While onboarding needs improvement, the app's overall flow does not require major adjustments, as it aligns well with user expectations.

7.7.1 User Interface (UI) Feedback Participants provided feedback on the app's user interface, particularly regarding design elements like icons. While there were no significant issues with functionality, several participants expressed a preference for aesthetic refinements. As P6 remarked, *"Where's the crown, because the kroon is a crown in Afrikaans,"* highlighting the desire for visual elements that align more closely with the app's cultural context. This feedback suggests that, although the user flow is intuitive, further refinement of the UI, especially in design elements, could enhance the overall experience. Improving the visual design to better meet user expectations would make the app more appealing and user-friendly, contributing to a more polished and engaging interface.

7.8 Feature Development Derived from Workshop Findings

Sections 7.1 to 7.7 outline critical insights from the community workshops, which directly shaped the design and functionality of the Kroon community voucher digital wallet. These sections provide key findings that address issues such as financial exclusion, ease of use, and security concerns within the Ocean View community. From these insights, specific features of the app emerged to cater to the community's needs. For example, the Kroon wallet integrates local voucher transfers to offer a simple alternative to traditional banking, given the financial exclusion faced by some community members. Additionally, the app includes a streamlined onboarding process and transaction alerts to ensure usability, reflecting the community's positive but sometimes challenging experiences with mobile banking apps. Security features are kept minimal, focusing primarily on transaction-related safeguards such as a PIN, in response to the low-risk perception among users. The features that emerged from these insights, highlighting how community input directly shaped the app's functionality and interface design, are summarized in Appendix Section G, H and I.

8 Discussion

The co-design process successfully captured the functional requirements of the community, ensuring that the wallet reflected their specific needs and desires. This participatory approach allowed for a deeper understanding of the community's preferences, enabling the app to be tailored accordingly[11].

Additionally, the process provided valuable insights, such as the preference to separate features like "Earn Kroon" and "Internet Voucher Top-Up" from the wallet itself. Initially, these features were intended to be part of the wallet, but participants indicated a clear preference for them to reside within the broader iNethi app. This finding underscores the importance of involving users in the design process, as it revealed a crucial distinction in how the purpose and functionality of the digital wallet were perceived.

Overall, these results demonstrate the effectiveness of co-design in creating a user-centered app that is both functional and aligned with the community's needs. By integrating participant feedback into the development process, the final product not only captures the functional requirements but also better suits the specific context in which it will be used. This study also supports previous research, confirming that involving users in the design process leads to more relevant and tailored solutions for the target population[11, 43, 46].

The research revealed that participants were generally unconcerned about security in the iNethi app's digital wallet, primarily due to the required login to access the app. They did not see the need for additional security layers, such as

separate logins for the wallet, reflecting a low perceived risk of loss. This relaxed attitude contrasts with prior studies that highlight stronger security concerns for apps handling sensitive data, such as financial or medical information [4].

This perception can be explained by the "privacy calculus" model, where users balance privacy risks against the benefits of using an app. With no connection to broader financial data, participants viewed the risk as minimal, which reduced their demand for more stringent security measures [18]. Previous research supports this finding, noting that security concerns increase when apps manage sensitive data [14].

However, participants did express a preference for added security, such as password prompts, when conducting transactions involving vouchers or tokens, aligning with other studies that show heightened concerns during financial activities [4].

Technical reliability was also highly valued, particularly features like password recovery and low data usage, reflecting the socio-economic context of the participants. The high cost of data motivated a strong preference for a "Low Data Usage Mode," highlighting the need for accessible and efficient functionality in low-income communities [18].

9 Study Limitations and Lessons for Future Research

In this research, the researcher's background played a dual role, offering both advantages and disadvantages.On the positive side, the shared background between the researcher and the participants helped establish rapport and trust. This commonality fostered a more comfortable environment, encouraging participants to be more open and honest during the workshops. As a result, the data collected was likely richer and more detailed. The researcher's empathy and deep understanding of the participants' context also facilitated a nuanced exploration of key issues. This allowed for the formulation of relevant questions and the accurate interpretation of cultural subtleties that an outsider might have overlooked. Furthermore, the shared experience bolstered the researcher's credibility, leading to more candid responses from participants.

However, this similarity also introduced potential drawbacks. The researcher's preconceived notions and personal experiences may have biased both the framing of questions and the interpretation of responses. This poses the risk of unconsciously guiding participants toward responses that align with the researcher's expectations. Additionally, participants may have tailored their responses based on their perceptions of the researcher, offering socially desirable answers rather than their genuine thoughts. Compounding this issue is the well-known intention-behavior gap, where participants' stated intentions may not align with their actual behavior in real-world scenarios. These factors could compromise the authenticity of the feedback, potentially undermining the external validity of the research and raising concerns about whether the workshop feedback accurately reflects real-world app usage.

Given these potential biases, it would have been helpful to implement data triangulation methods, such as using surveys, which would have prevented the researcher from probing participants into responses that aligned with their own assumptions. Additionally, having an external notetaker during workshops two and three, rather than relying on the researcher's own field notes, could have reduced bias. Furthermore, the presence of an external observer in these workshops would have added another layer of objectivity. Finally, the thematic analysis conducted was not thorough, presenting another limitation in terms of the quality and depth of the findings.

9.0.1 Time Constraints and Limited User Engagement

The research's short time frame limited participants' engagement with the app beyond the workshop, reducing the diversity of user experiences and feedback, particularly regarding its long-term use. The brief data collection period also hindered the observation of potential trends, impacting the research's reliability and validity. Additionally, delays in app updates and a lack of functionality for sending vouchers meant participants were not incentived to engage fully. Consequently, the usage data presented in Appendix Section J shows a low number of clicks, most of which are from my own testing and development of the app, further compromising the research's external validity and generalizability.

10 Conclusions

The findings emphasize the importance of tailoring financial tools to local contexts and involving users in the design process. Community feedback shaped the Kroon wallet's design, with participants favoring core financial transactions and integrating features like "Earn Kroon" and "Internet Voucher Top-Up" into the broader iNethi app.

Though security was important, the wallet was viewed as low-risk, leading to a preference for simple measures like a PIN over complex authentication.Overall, the co-design approach effectively captured the community's needs, resulting in a wallet that aligns with their local context and priorities. The Kroon wallet shows potential for enhancing financial inclusion within Ocean View and could serve as a model for developing similar tools in other underserved communities.

Future research should assess the wallet's long-term impact on financial inclusion and its potential to guide the development of localized financial solutions, demonstrating the value of co-design in creating accessible tools for underserved populations.

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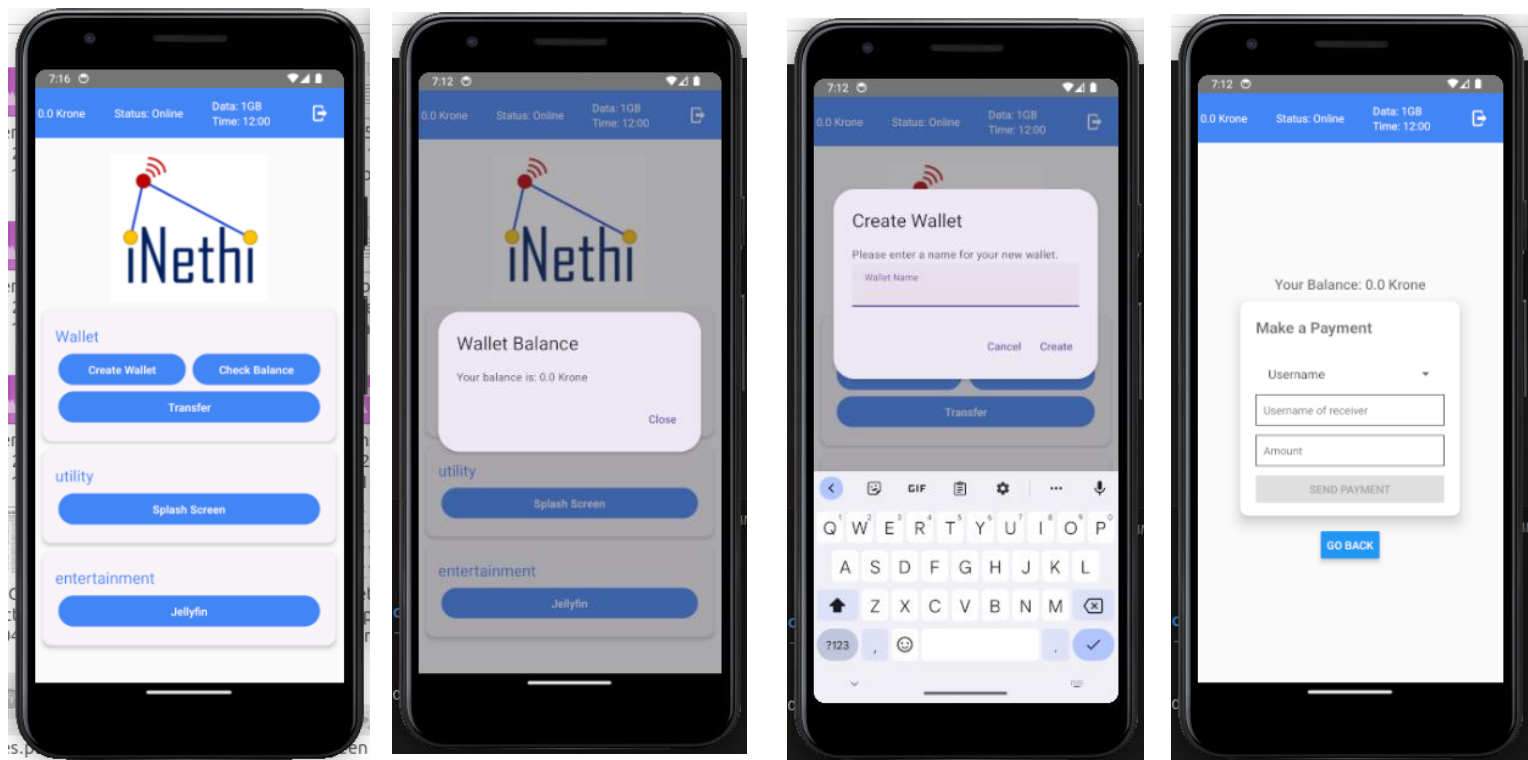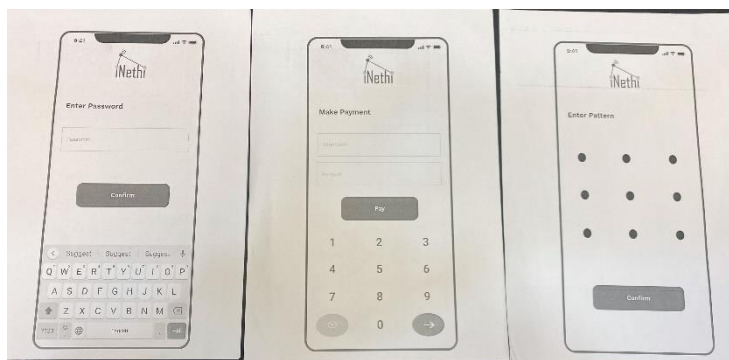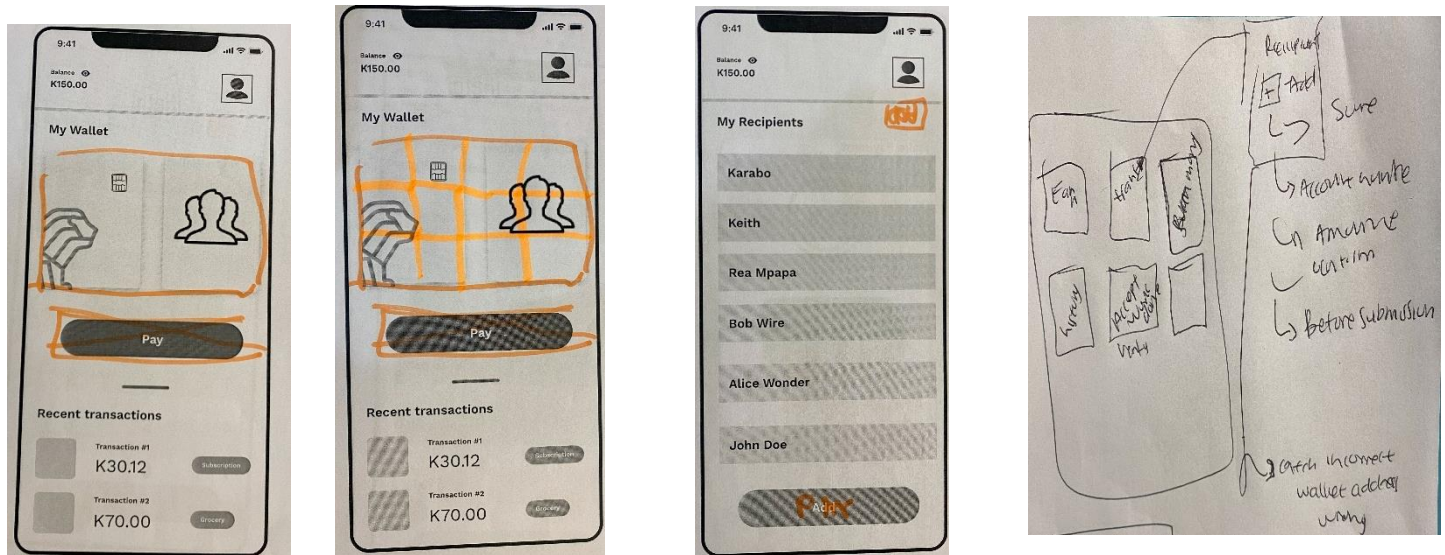
Appendix

Section A – Wallet Embedded with the iNethi-App
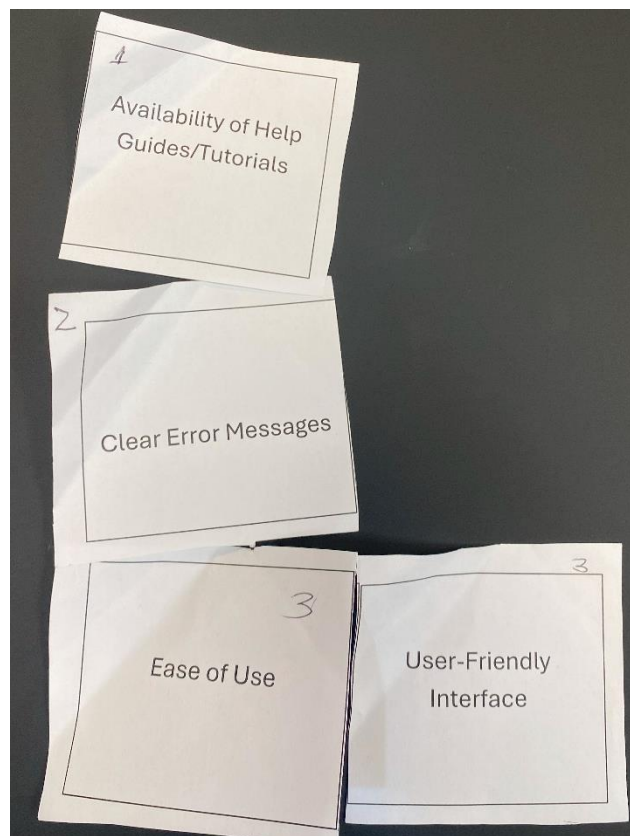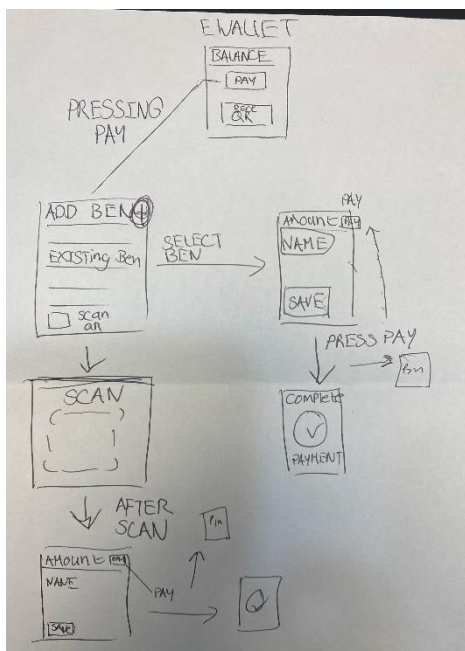

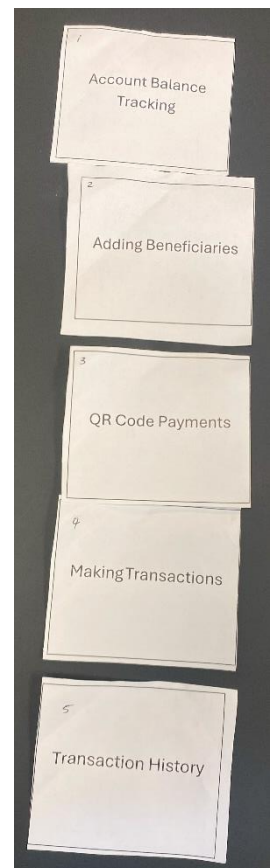## Section B – Flat System Architecture
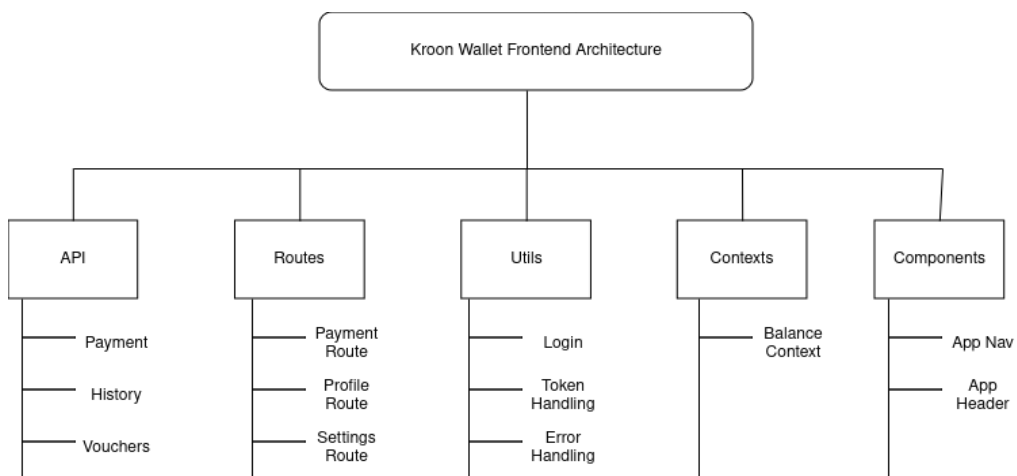
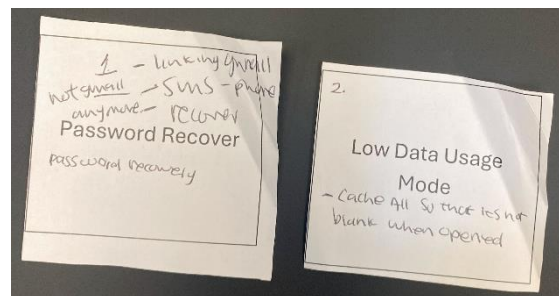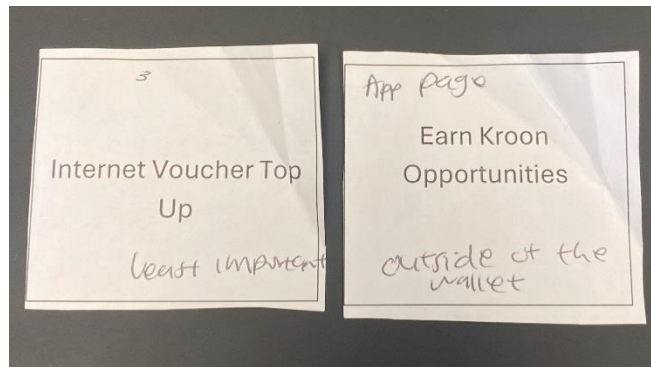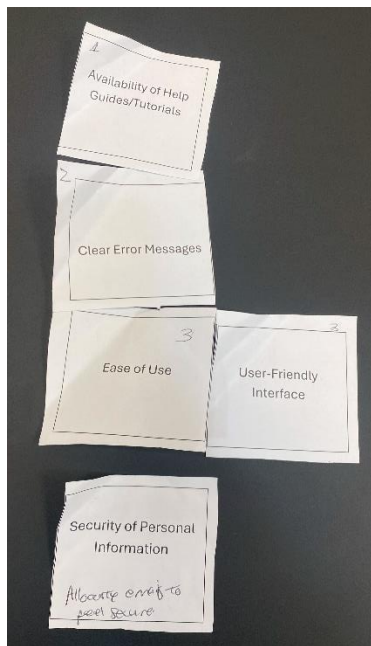## Section C – Version 1 of Wallet (Starting Point)

Section D - Workshop 1 Artifacts

Section E – Workshop 2 Artifacts

Availability of Help Guides/Tutorials

Clear Error Messages

Ease of Use

User-Friendly Interface

Security of Personal Information

Allocate one to feel secure

Internet Voucher Top Up

Least important

App page

Earn Kroon Opportunities

outside of the wallet

1 – linking gmail
hotgmail →SMS →phone
anymore → recover
Password Recover
password recovery

2.
Low Data Usage Mode
– cache All surface less hit blank when opened

Account Balance Tracking

Adding Beneficiaries

QR Code Payments

Making Transactions

Transaction History

E WALLET
BALANCE
PAY
SCAN QR

PRESSING PAY

ADD BEN
EXISTING Ben
SELECT BEN
scan qr
SCAN
AFTER SCAN
AMOUNT
NAME
PAY
SAVE

AMOUNT PAY
NAME
SAVE
PRESS PAY → Ben
COMPLETE
PAYMENT

Availability of Help Guides/Tutorials

Clear Error Messages

Ease of Use

User-Friendly Interface

15

Section F – Cognitive Walk Through Used in Workshop 3

Task Prompt

App Registration and Onboarding 1. What do you expect to see after opening the app for the first time? 2. How would you begin the registration process? 3. How do you know your details were saved during registration? 4. How does the app notify you of errors (e.g., invalid email)?
Viewing Wallet Balance 1. Where do you expect to find your wallet balance? 2. Is the wallet balance displayed clearly? 3. How does the app notify you if the balance fails to load?
Sending Vouchers 1. Where do you find the "Send Vouchers" option? 2. Are the steps for selecting a recipient and entering an amount clear? 3. How easy is it to edit recipient information or the amount? 4. How do you know the voucher was successfully sent? 5. How does the app notify you of transaction failures (e.g., insufficient balance)?
Receiving Vouchers 1. How were you notified that you received vouchers? 2. How do you confirm the vouchers were added to your wallet? 3. How would you expect to be notified if you are not logged in?
Viewing Transaction History 1. Where do you find the "Transaction History" feature? 2. Is the transaction history displayed clearly? 3. How does the app communicate that there are no transactions?
Using QR Codes for Payments 1. How do you access the option to scan a QR code? 2. What would you do if the QR code scan fails? 3. How does the app confirm the recipient's details after scanning the QR code? 4. How easy is it to generate your own QR code to receive vouchers?
Managing Wallet Recipients 1. Where do you view or manage a list of past recipients? 2. How would you remove a recipient from the list? 3. How do you handle sending vouchers to the wrong recipient?
General Usability and Feedback 1. Is feedback for each action clear (e.g., confirmations, errors, notifications)? 2. How would you seek help or support if you encountered an issue?

Section G – Use Cases Derived From Workshops

Register Wallet Use Case

Section	Details
Pre-condition	- User must have access to the app - User selects the registration option
Post-condition	- A new wallet is created and linked to the user's profile
Basic Path	1. User selects **'Register'**. 2. System prompts user to enter details (name, email, etc.). 3. User provides necessary information. 4. System creates the wallet and links it to the user's profile. 5. System confirms successful registration.
Alternative Path	- At step 3, if invalid details are entered: System prompts user to re-enter correct details.
Exceptional Path	- At step 4, if wallet creation fails due to server issues: System shows an error message and retries the process.

Show Balance Use Case

Section	Details
Pre-condition	- User is logged into the app - User has a registered Kroon wallet
Post-condition	- User's current wallet balance is displayed
Basic Path	1. User navigates to **Kroon Wallet** section. 2. System retrieves balance from the server. 3. System displays the current balance.
Alternative Path	- If balance retrieval fails: System shows an error message and prompts user to try again.
Exceptional Path	- If server is down, system retries fetching the balance or alerts the user to check later.

Send Voucher Use Case

Section	Details
Pre-condition	- User has sufficient balance - Recipient has a registered Kroon wallet
Post-condition	- The recipient's balance is increased, and the sender's balance is reduced
Basic Path	1. User selects **'Send Vouchers'**. 2. User enters recipient details (wallet address or username). 3. User enters the amount to send. 4. System verifies the recipient's details and available balance. 5. System processes the transaction and updates both balances. 6. Confirmation message is displayed.
Alternative Path	- At step 2, if the recipient's wallet address is invalid: System displays an error message and prompts the user to re-enter correct details.
Exceptional Path	- If insufficient funds: System alerts user with a message stating **'Insufficient balance'** and cancels the transaction.

Transaction History Use Case

Section	Details
Pre-condition	- User has made or received transactions in the past
Post-condition	- User's transaction history is successfully displayed
Basic Path	1. User navigates to the **'Transaction History'** section. 2. System retrieves all past transactions linked to the wallet. 3. System displays the transaction list, including details like date, recipient, and amount.
Alternative Path	- If no transactions exist: System displays a message indicating no transactions available.
Exceptional Path	- If the system fails to retrieve the transactions due to network issues: System alerts the user to try again later.

Receive Voucher Use Case

Section	Details
Pre-condition	- Recipient has a registered Kroon wallet - Sender has initiated the transaction
Post-condition	- Recipient's balance is updated to reflect the received vouchers
Basic Path	1. Sender sends vouchers to the recipient. 2. System notifies the recipient of the incoming vouchers. 3. System credits the recipient's wallet. 4. Recipient checks the balance update.
Alternative Path	- At step 2, if the recipient is not logged in: The system stores the notification and delivers it when the recipient logs in.
Exceptional Path	- If the recipient's wallet is not found: System alerts the sender of an invalid recipient, and the transaction is reversed.

Send Voucher Use Case

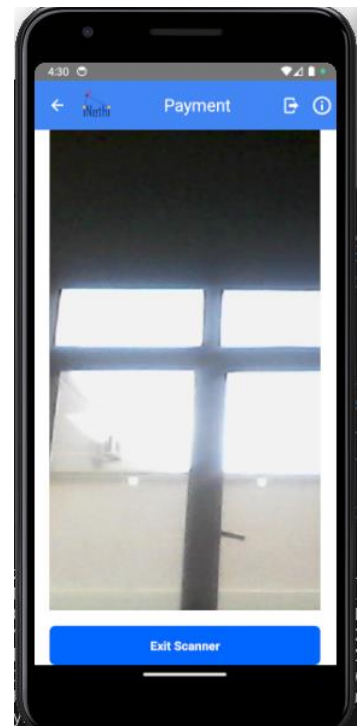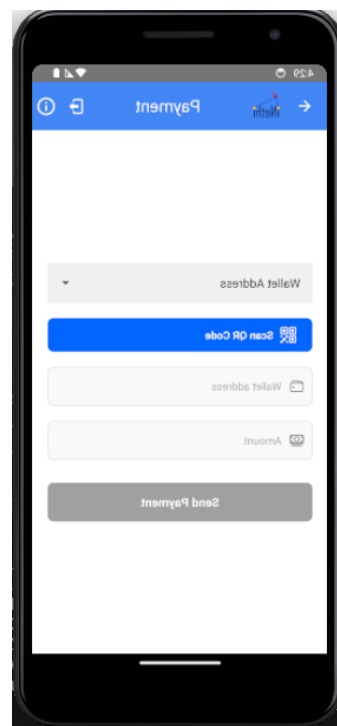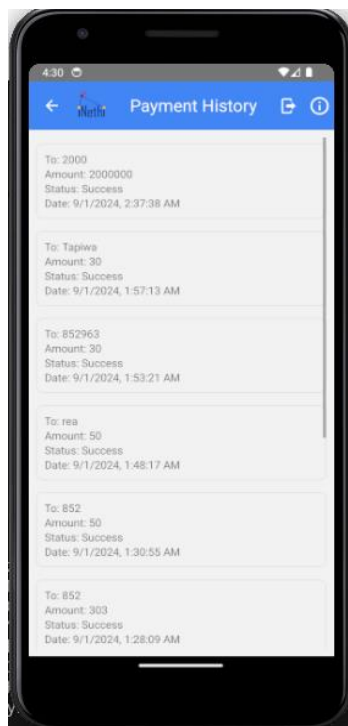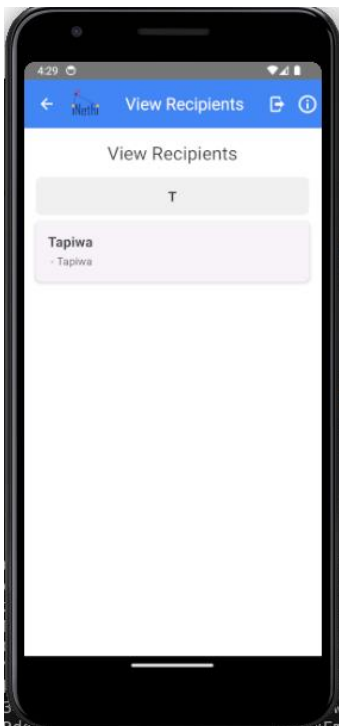| Section	Details
Pre-condition	- Both sender and recipient are registered with Kroon wallets
Post-condition	- The transaction is successfully processed, and both balances are updated
Basic Path	1. User selects **'Send Vouchers'** and chooses the **'Scan QR Code'** option. 2. System opens the camera and prompts the user to scan the recipient's QR code. 3. User scans the recipient's QR code. 4. User enters the amount to send. 5. System processes the transaction and updates both balances. 6. System displays a confirmation message.
Alternative Path	- If QR code scanning fails: System prompts the user to retry or enter recipient details manually.
Exceptional Path	- If transaction fails due to insufficient funds: System alerts the user and cancels the transaction.

Wallet Recipients Use Case

Section	Details
Pre-condition	- User has previously sent vouchers to recipients
Post-condition	- The user's recipient list is successfully displayed
Basic Path	1. User navigates to the **'Wallet Recipients'** section. 2. System retrieves the list of recipients. 3. User views recipient details or selects a recipient to send new vouchers.
Alternative Path	- If no recipients exist: System displays a message indicating no previous recipients.
Exceptional Path	- If system fails to retrieve recipient list: System alerts user to retry or shows an error message.

Section H - Requirements Gathered from Workshops

Functional Requirement	Description
Onboarding and Account Creation	
Clear and explicit instructions for sign-up	The system must provide clear and explicit instructions for first-time users to create an account, specifying the details required for sign-up.
Step-by-step guide for onboarding	The onboarding process must include a step-by-step guide for new users, ensuring they understand the actions required to complete the sign-up process.
User Interface (UI) and User Experience (UX)	
Intuitive icons and labels	The UI must display clear, intuitive icons and labels for key functionalities, such as balance tracking, adding beneficiaries, and transaction history.
Visual feedback for actions	The system must provide visual feedback for user actions (e.g., buttons changing state when pressed, confirmation messages after completing actions).
Simple navigation	The system must allow users to navigate the app without requiring complex actions, ensuring that the user flow is simple and intuitive for all users.
Clear error messages	The UI must include clear and concise error messages that provide guidance on how to resolve any encountered issues.
Core Wallet Features	
Real-time balance display	The system must allow users to view their account balance in real-time on the wallet home screen.
Transaction history display	The system must allow users to view their transaction history, including a list of past transactions with dates, amounts, and recipients.
Adding beneficiaries	The system must enable users to add beneficiaries to their account, allowing them to send Kroen to trusted recipients with ease.
Simple transaction process	The system must provide a simple, intuitive method for users to transfer Kroen to beneficiaries, with confirmation before the transaction is completed.
Security and Authentication	
Flexible authentication options	The system must provide flexible authentication options (e.g., password, PIN) that users can choose from during sign-up or in their account settings.
Password recovery	The system must offer a password recovery mechanism, allowing users to reset their password via SMS, email, or a similar familiar method (e.g., Gmail recovery).
Transactional Features	
Notification for received Kroen	The system must allow users to receive Kroen from others, including a simple notification system to confirm that the transaction was successful.
Low data usage and offline mode	The system must enable users to manage their Kroen balance and transactions with minimal data usage, including an offline mode for previously viewed information.
Help and Support Features	
Help section and tutorial	The system must include a help section or tutorial that guides users through the basic functionalities of the app (e.g., sign-up, transferring Kroen, viewing balance).
Error handling	The system must display help messages and error handling when a user encounters difficulties during key tasks (e.g., failed login or invalid inputs during a transaction).
Community Engagement Features	
Store directory for services	The system must allow users to browse a store directory where community members list services they offer in exchange for Kroen.
Rewards for community behaviour	The system must include a rewards feature, where users can earn Kroen or vouchers for engaging in positive community behaviour (e.g., volunteering or offering services).

Section I – User Interface Resulting from Co-Design Workshops
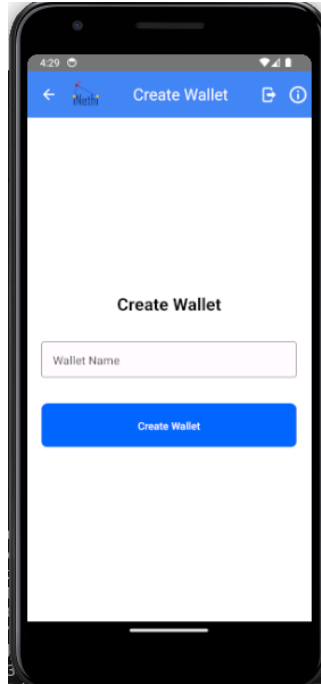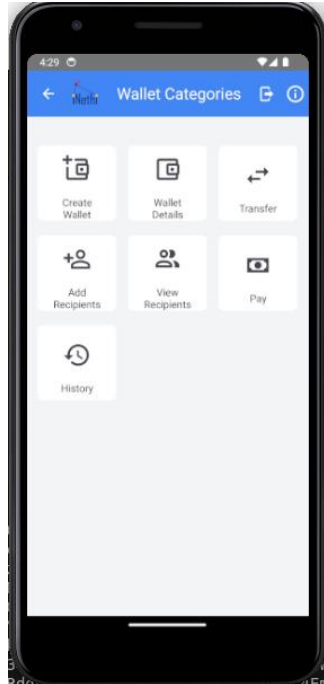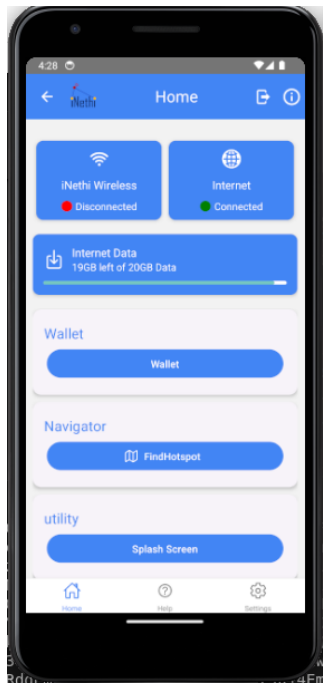
Section J – Number of Clicks for Wallet Categories

Wallet Category	Number of Clicks
Create Wallet	6
Wallet Details	60
Transfer	32
Add Recipients	18
View Recipients	44
Pay	20
History	33