Building The iNethi Mobile Application Honours Proposal

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Abstract

This project aims to address the underutilization of local content services within the iNethi Community Wireless Network (CWN) in Ocean View, South Africa, by developing an integrated mobile application. The application consolidates all iNethi services onto a single platform, offering offline access to content, real-time updates on WiFi hotspot availability, and management of community vouchers. Through co-design workshops and iterative development, the app is tailored to meet the needs of the Ocean View community, with a focus on usability and accessibility. The project employs Agile methodology, incorporating regular sprints, user feedback sessions, and extensive testing, including simulation on the iNethi Testbed to ensure compatibility with network conditions in OceanView. By analyzing data usage metrics and user engagement, the effectiveness of the application in increasing local service utilization and community voucher transactions will be evaluated. Overall, the project aims to empower individuals in Ocean View to access information, fostering inclusive growth and development within the community.

Keywords: Community Wireless Networks, Local Services, Internet Access, Community Currency

1 Introduction

Despite over 3.1 billion people worldwide being connected to the internet, a staggering 4.2 billion still lack access, representing approximately 58% of the global population[35]. This digital divide persists due to various factors, including prohibitively high data costs, with South Africa notably experiencing some of the highest mobile internet expenses globally[12]. Access to the internet is no longer a luxury but a necessity, as it facilitates crucial economic, educational, social, and cultural opportunities. Marginalized groups, such as minorities, low-income individuals, and rural populations, are disproportionately affected by this lack of connectivity, further widening existing disparities[17]. Community Wireless Networks (CWNs) have emerged as a collaborative solution to bridge these gaps, providing shared telecommunication infrastructure for collective benefit. However, current CWNs do not offer nomadic broadband access, necessitating alternative means for users to connect when not within network range[1, 20].

iNethi is a non-profit organization led by the University of Cape Town (UCT) that focuses on ICT4D initiatives, aiming to establish infrastructure to support community-based services and content sharing. The organization's ethos revolves around empowering individuals in the creation, management, and cost-sharing of wireless networks. One of iNethi's deployments is in Ocean View, Western Cape, South Africa[15].

In Ocean View, although local content services are utilized to some extent, their usage significantly trails behind the usage of services outside of the network. During the period from December 2019 to May 2020, internet traffic amounted to 163 GB, while local services accounted for only 1.8 GB, with some internet traffic attributed to system updates. This discrepancy in usage suggests a potential design flaw in the interface, possibly leading to reduced awareness of local services. It's speculated that people primarily discover these services through word of mouth rather than through the voucher interface. The interface design and lack of awareness are hypothesized to contribute to the notably lower usage of local content and services[12]

We aim to address the underutilization of local content within the iNethi deployment in OceanView by developing an application that consolidates all of iNethi's content services onto a single page, eliminating the need for users to remember individual URLs. This streamlined approach seeks to boost participation in iNethi's offerings. To achieve this goal, we are implementing three key strategies. Firstly, we will introduce a service within the application that displays the uptime and availability status of local WiFi access points, enhancing users' awareness of network accessibility. Additionally, users will have the capability to check their internet voucher balance directly from the app, simplifying the process of managing their connectivity. Lastly, we will integrate functionality for users to engage with the community voucher within the app, fostering a sense of community involvement and incentivizing participation in iNethi's services. Through these initiatives, we aim to encourage greater utilization of iNethi's resources and promote active engagement within the community.

2 Background

Community Wireless Networks (CWNs) have emerged as collaborative initiatives where communities come together to

establish shared telecommunication infrastructure for their collective benefit. Local networks play a crucial role in bridging connectivity disparities by extending services to often overlooked or underserved communities, groups, and individuals. Community-owned wireless networks aim to tackle the connectivity challenges prevalent in underserved areas by constructing localized internet infrastructure and offering essential services. One of their primary objectives is to mitigate bandwidth limitations by hosting web content and various internet services within the community network infrastructure[1, 36].

2.1 iNethi

iNethi, is a non-profit organization led by the University of Cape Town (UCT) that focuses on ICT4D initiatives, aiming to establish infrastructure to support community-based services and content sharing. Several services hosted on iNethi include educational content, local business-related content and music sharing. The organization's ethos revolves around empowering individuals in the creation, management, and cost-sharing of wireless networks. One of iNethi's deployments is in Ocean View, Western Cape, South Africa[15]. The Ocean View Community Wireless Network (OVCWN) is a mesh wireless network owned by the community itself, operating in South Africa. Through this network, residents can access local resources and the internet at affordable rates by sharing a collective connection. The Inethi Network serves as a cloud platform at the edge, facilitating content and service sharing within the community[19].

OVCWN currently operates 20 hot spots, accessible to anyone within their range. Inethi Network empowers the Ocean View community to utilize wireless communication to enhance digital participation, amplify the value of local resources, and foster community cohesion. Additionally, Inethi Network ensures data backup and remote access by syncing with a corresponding instance hosted by Amazon Web Services. Community members can purchase vouchers priced at R20/GB, offering a substantial discount compared to the lowest-priced 1GB vouchers available from mobile operators in South Africa[19, 36].

2.2 CWNs and Local Services

Applications within community networks (CNs) serve as motivators for individuals to join, offering a range of services from connectivity to communication and entertainment. CNs host various applications, with some focusing on internet access while others provide additional services like communication tools and entertainment[25]. CN services and applications that store or process data locally incentivize privacy by avoiding exposure to commercial data storage practices. Distributed cloud solutions, such as Cloudy in Guifi.net, illustrate this concept[24, 25].

Other examples of services that can be hosted on CWNs include Crowdsourcing applications that are well-suited to the participatory nature of CNs, facilitating the exchange of information and services among community members and VoIP services, where nomadic users utilize community-based internet access for low-cost communication[24]. While internet access is often the primary service, community networks have the unique opportunity to provide local-interest services within the network. Leveraging cloud technologies, they can collectively build community clouds, expanding the range of services available to users[29].

2.3 Community Financial Services

Community currencies, also known as complementary currencies, social currencies, or local currencies, are alternative monetary systems that operate alongside conventional currencies, aiming to promote financial inclusion, local development, and social cohesion. These currencies facilitate exchanges of goods and services within specific communities or geographic regions keeping wealth circulating within the community and supporting local businesses. They represent agreements to use something other than legal tender, complementing rather than replacing national money[18, 22, 23].

Community currencies come in various forms, including physical paper-based or digital records, and serve diverse objectives, from crisis response to promoting sustainable development.With the widespread adoption of technology, there has been a shift towards digital community currencies, including digital crypto community currencies like the Sarafu community digital currency in Kenya, reflecting the evolving nature of these alternative monetary systems[3, 13, 21].

The Krone, a community voucher native to Ocean View, serves as a key component in ensuring the sustainability of the community wireless network. Through the Krone system, individuals who act as stewards of the network infrastructure, such as Wi-Fi antenna hosts, are rewarded with Krone tokens. These tokens can then be exchanged for internet services or other locally curated content that supports the Krone economy. Beyond merely sustaining the community wireless network, the Krone community voucher plays a pivotal role in redirecting locally generated wealth back into the community. By incentivizing community members to engage with and support the local economy, this approach prevents resources from being siphoned off to distant corporations, thereby fostering increased local economic activity and bolstering support for indigenous businesses[23, 37].

3 Related Work

Several academic studies have delved into the significant barriers and challenges faced by users in developing regions regarding access to mobile applications and the internet. Fernandes et al.investigated the difficulties associated with achieving stable and affordable internet connectivity, particularly in remote areas far from major cities. Their study highlighted the prevalent outages and service disruptions

experienced by many users, necessitating the provision of offline access to enable interaction with social content when internet connectivity is unavailable[16]. Do et al. explored the effectiveness of 3G/4G data plans subscribed to by users in developing regions. Their research uncovered various factors contributing to the ineffectiveness of these plans, including sporadic wireless network availability, limited energy budgets of battery-powered devices, and escalating data plan costs driven by volume usage[14].

Xie et al.conducted a study focusing on the challenges encountered by larger mobile applications in constrained networks. Their findings revealed that such applications often experience stability or usability issues, impeding access to critical apps essential for economic and educational development[39].Sambasivan et al.argued for the adaptation of design considerations in mobile applications to accommodate technical irregularities prevalent in slum habitats. Their study emphasized the disruptive nature of infrastructural failures and economic constraints on user interactions, highlighting the need for tailored solutions to address these challenges effectively[28]. Collectively, these research endeavors provide valuable insights into the multifaceted barriers hindering access to mobile applications and the internet in developing regions, underscoring the urgency for targeted interventions to facilitate sustainable economic and educational development.

3.1 Local Wifi-Hotspots Maps

There are several initiatives and organizations actively working to diminish the digital divide in South Africa and empower under-served communities through equitable internet access.Think WiFi, SmartCape, and Project Isizwe are among the notable initiatives addressing this issue.
Think WiFi deploys free Wi-Fi services known as 'ThinkZones' in under-serviced communities, offering uncapped Wi-Fi with speeds up to 30 Mbps. They leverage a digital advertising platform to provide free internet access for those in need while also creating measurable community impact[1]. Similarly, SmartCape focuses on expanding public internet access in Cape Town by installing Wi-Fi zones in public buildings and spaces, providing residents with 50MB of free data daily. Additionally, SmartCape enhances connectivity for passengers through Wi-Fi-equipped MyCiTi buses[2]. While Project Isizwe contributes to the cause with the Tshwane Free WiFi project, deploying over 1050 public WiFi hotspots across the city and offering 500MB of free WiFi daily[3].
These organizations share a vision for uncapped internet access, aiming to ensure connectivity in every classroom to enable relevant teaching and learning experiences for all citizens, fostering their ability to thrive in the global digital economy. Moreover, both Think WiFi and SmartCape initiatives provide user-friendly maps to aid individuals in locating Wi-Fi hotspots within their networks, facilitating easy navigation and maximizing connectivity utilization. These concerted efforts signify a step towards bridging the digital gap and empowering communities across South Africa.

3.2 Applications

The work that is closest to the work we plan to do is the MoyaApp. The MoyaApp is a free platform accessible to all South Africans, offering data-free messaging and access to over 300 data-free websites and apps, covering various categories like news, sports, education, and essential services. Recently, MoyaApp introduced MoyaPay, allowing users to conduct various financial activities seamlessly. However, downloading the Moya Messenger Instant Messaging (MIM) still requires 15.8 MB of data, and network access from Moya's partner providers is necessary, posing challenges, especially in rural areas. Additionally, MoyaPay is limited to business transactions, excluding regular South African users.

MoyaApp, despite its commendable efforts in providing free access to content services and facilitating data-free messaging, faces several limitations. Firstly, its initial download size of 15MB poses a barrier for users with limited bandwidth or data constraints. Additionally, reliance on specific network providers and the need for network access for full functionality excludes those not serviced by these partners, and those without network access, especially those in rural areas with limited network coverage. Furthermore, the app's transactional capabilities are restricted to business use and not individuals, its does not cater to individuals without bank accounts, perpetuating financial exclusion and doesn't support community currencies[4].

4 Problem Statement and Aims

Despite the wide range of services offered by the iNethi network, users of the network in OceanView are currently not using the services made available to them.

Observations suggest that users are not using the services because there is a lack of a unified portal that allows users to engage with iNethi's diverse services and that the connectivity limitations that the users face stop them from accessing the services when they are not connected to the network. Consequently, there is a need for a single, integrated platform that facilitates uninterrupted access to iNethi services and ensures content availability regardless of network connectivity.

[1] https://www.thinkwifi.online/
[2] https://www.capetown.gov.za/local%20and%20communities/get-online/Public-Wifi-Zones/welcome-to-smartcape
[3] https://projectisizwe.org/about-us/
[4] https://moya.app/our-story/

4.1 Aims

The aim of this project is to increase the usage of the local services in the iNethi Network in OceanView. To achieve this aim to plan to integrate all iNethi services into an offline-compatible app. This app will not only allow users to access iNethi content offline but also provide features such as tracking the users internet voucher usage, facilitating transactions using the Krone community vouchers and the ability to view local wifi hot spots and their status. The app will be divided into three parts for this project, namely, the map and voucher system interface, local content services integration and a community voucher digital wallet.

4.2 Map and Internet Voucher

Exploring the challenges users face when connecting to community wireless networks such as iNethi reveals significant technical and socio-economic barriers. Research by Chetty indicates users often deal with technical difficulties such as signal interference and limited network reach due to the ad-hoc nature of these networks [7, 26, 32]. Marshini's research suggests that these technical challenges are exacerbated by inadequate user interfaces, which could be improved with clearer visual indicators of network status to enhance user interaction [6, 8]. Additionally, Michael Anne Thomas highlights that affordability and the level of digital literacy significantly impact network access. She advocates for interfaces that are designed to be accessible and accommodating to a broad user base [5, 33].

In response to these issues, developing a dynamic map interface could be a practical solution. This map would not only pinpoint hotspot locations but also provide real-time updates on their operational status, addressing the visibility concerns raised by Chetty and inclusivity issues highlighted by Thomas [27, 34]. Integrating user feedback mechanisms into this interface could further empower users by allowing them to report connectivity issues, enhancing network management and potentially improving reliability and user satisfaction [4]. Addressing technical challenges such as signal loss and environmental barriers will be essential for implementing this solution effectively [2, 10, 11, 30, 38].

4.3 Local Content Services

Users in Ocean View primarily interact with iNethi local services using devices such as laptops and smartphones, which connect to the internet through wireless hotspots; some devices are connected via Ethernet. They access various iNethi services by manually typing the URLs into their preferred web browsers when connected to these networks. This interaction pattern suggests a reliance on traditional access methods that may not fully support user mobility or offline access.

The primary challenges they face include difficulty in remembering the specific URLs needed to access each service, since the services are scattered across different web addresses. Additionally, when they are not connected to the local hotspots, they are unable to access these services at all, highlighting a significant gap in service accessibility outside the range of these network connections. Further research by Phokeer et al. highlights that a significant portion of the community uses outdated Android versions, complicating the potential design of universally accessible applications. This underlines the need for a mobile solution that accommodates low-end devices and can provide offline functionality to bridge these connectivity gaps.

4.4 Digital Wallet

The lack of trust in traditional banking, combined with cultural beliefs, often deters individuals with low incomes from accessing financial services. Factors such as financial illiteracy, high bank fees, and misleading advertising exacerbate this issue. Consequently, many low-income earners prefer trust-based models like stokvels, which are community-based and offer simplicity and familiarity[9, 31]. However, financial exclusion hinders socio-economic development and limits access to essential services. To address this, community currencies have emerged[13]. This part of the project aims to design a user interface for a community voucher digital wallet that closely resembles community currencies.

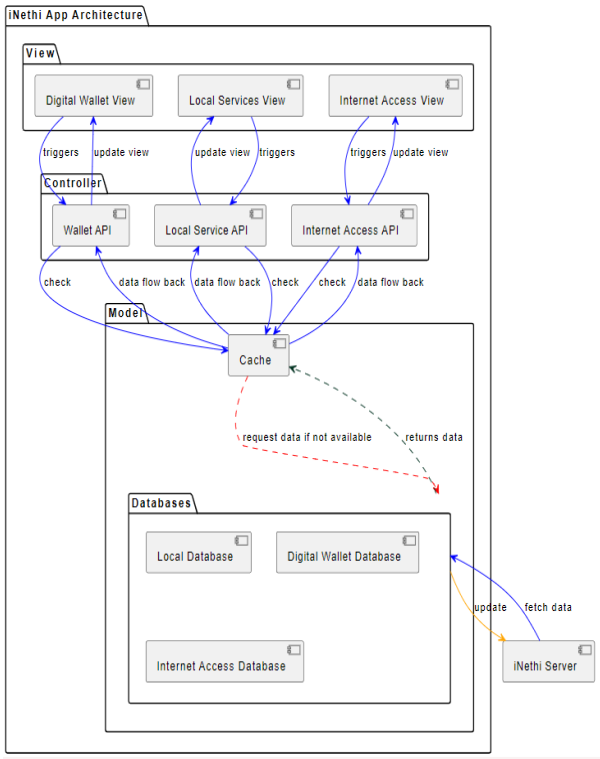
5 iNethiApp

5.1 Existing Work

For this project, we are not commencing from a clean slate; rather, we're building upon existing services and infrastructure. The services, such as radio, content sharing, and the community voucher, that we hope to integrate into the app are already available and implemented. Our goal is to enhance the usability of these services, making them more accessible and user-friendly. Additionally, we have a very basic app serving as a minimum viable product, which we will be extending and refining to better meet user needs and improve usability.

Security is of paramount importance, particularly given that our app facilitates transactions using community vouchers. Presently, users are required to sign in to the iNethi network via Keycloak software, ensuring a certain level of security through single sign-ons. The community voucher system currently employs USSD codes, with a 4-digit PIN serving to secure the wallet. We plan to enhance security by implementing a single sign-on requirement when opening the app and integrating a 4-digit PIN system, similar to that used with USSD codes, to access the wallet within the app.

5.2 Architecture



The iNethi mobile app, adhering to the Model-View-Controller (MVC) pattern, is designed for seamless integration with the existing local iNethi server infrastructure to enhance the community's digital experience in Ocean View. The app's architecture is lightweight and intuitive, ensuring accessibility and ease of use for all community members, as well as straightforward maintainability for future advancements.We are integrating Single Sign-On (SSO) into the iNethi mobile app's architecture to enhance security and simplify user access across different services. With SSO, users can log in once and access multiple services within the iNethi network without the need to sign in separately for each service. This feature not only makes access easier but also improves security by reducing the risk of password-related breaches. SSO achieves this by centralizing the authentication process, which allows for better control and monitoring of user activities.

In the refined architecture, the View layer is divided into three specific interfaces: Digital Wallet View, Local Services View, and Internet Access View, each crafted to provide a seamless user experience across different devices with the aid of React Native. This approach not only maximizes accessibility but also scales up to meet the diverse needs of the community.

The Controller layer is segmented into three distinct APIs namely the,Wallet-API, Local Service API, and Internet Access API each dedicated to processing requests from its corresponding view. This division into three separate APIs prevents a single point of failure and promotes efficient handling of requests tailored to the service being accessed.

In the Model layer, three separate databases—Local Database, Digital Wallet Database, and Internet Access Database—alongside a smart caching system, are implemented to enhance the app's responsiveness. Caching is leveraged to reduce frequent data fetching from the server, thus optimizing the performance and reducing the load on the iNethi Server. The SSO system will interact directly with the Model layer's databases ensuring that authentication credentials are consistently applied across all access points.

When the cached data is unavailable, the Model layer's caching mechanism interacts with the appropriate database to determine the necessity of fetching fresh data. If needed, the database then sends a request to the iNethi Server. This architecture reduces the app's dependency on external cloud services and enhances data transfer efficiency. The system's synchronization processes, including periodic syncs and push notifications, are designed to keep the app current, enabling offline access to the latest content and ensuring users can seamlessly retrieve up-to-date information when online connectivity is re-established.

The architecture includes security measures like encrypted data transmissions and secure authentication methods to safeguard user privacy. User experience is further enhanced through caching strategies and adaptive content delivery that aligns streaming quality with connection speeds.

6 Procedures and Methods

6.1 Key Terms

- Local Content Services:Services provided via the community wireless network accessible to OceanView residents without additional charges.
- Local Content Services: Services provided via the community wireless network accessible to OceanView residents without additional charges.
- Community Voucher (Krone): A voucher used within OceanView for transactions and promoting local services.
- Co-Designed Application: An application developed collaboratively with input from end-users, stakeholders, and developers.
- Data Usage Categories:
  - Paid Internet: Data used for accessing external services beyond the community network.
  - Whitelisted Services: Global internet services made freely accessible within the community network.
  - Local Services: Services hosted within the community network, freely accessible to locals.

6.2 Recruitment Strategy

Our goal is to enlist 18 to 20 participants from OceanView to take part in this project. Recruitment will be outsourced to Ganief from Black Equation, who has strong connections with the iNethi Network and the Ocean View community, who will send invitations through the community WhatsApp group. Interested individuals can then register and attend the workshop. Ganief will be compensated for his facilitation efforts, and participants who volunteer to take part in the workshops will receive a R50, along with a meal. Convenience sampling will be used for participant recruitment due to its practicality, efficiency, and alignment with the project's focus on community engagement. This method allows quick access to willing participants within Ocean View, South Africa, facilitating timely data collection and feedback gathering.

6.3 Data Collection

At the project's outset, we will assess the previous month's data usage on the Inethi network in OceanView, analyzing the overall data consumption as well as usage on paid internet, whitelisted services and local services.Additionally, we will examine the volume of krone transacted and the number of transactions utilizing the krone. Following this, we will deploy a basic application (app version 1) encompassing all Inethi services available in OceanView, equipped with tracking functionality to monitor app usage and individual service usage, such as the digital wallet for the community voucher. Usage data for both the app and its services will be recorded and tracked over a span of four weeks.

Given the uncontrolled nature of network data usage metrics, which could be influenced by external factors such as increased advertising of local services by OceanView vendors, we will rely on app usage metrics to maintain the integrity of our project. During the six-week data gathering period for the basic app, we will engage in co-design workshops with the community to develop an improved version of the app (app version 2). At the conclusion of week six, we will reassess data usage on the network (noting how much of the total data usage is due to the app) and deploy the improved app.

Subsequently, after four weeks of deploying the improved app, we will conduct the final measurements for the project such as the overall data consumption as well as usage on paid internet, whitelisted services, and local services.We will also analyze the volume of krone transacted and the number of transactions utilizing the krone.

6.4 Workshops

We are organizing three workshops to evaluate our application's performance through direct interaction with the Ocean View community and UCT students and staff. In these sessions participants will test our prototypes and provide feedback. The two workshops in Ocean View will explore whether the application meets user needs and help gather feedback on the usability and overall user experience of the application. Each workshop will feature both paper prototypes and a functional app prototype that participants can install on their phones and test.

The initial workshop is scheduled for the first week of June, where we will introduce the basic application developed by Keegan and iNethi personnel, alongside an enhanced paper-based prototype. This workshop session is meant to get feedback on the minimum viable product and get ideas as to what they would like to see in the next iteration of the app. Following sessions will occur every three weeks, allowing us to integrate the feedback into the latest iteration of the app and rigorously test the application before each new workshop. The second session, in mid-June, will assess the second version of the app with UCT students and staff in the same mode as the first workshop. The third workshop, set for the first week of July, will officially launch the application in OceanView.

At UCT, the focus will be on testing the application's effectiveness on the iNethi Network by simulating Ocean View's network conditions using the iNethi testbed. The main reason for the test at UCT is that due to time constraints and limited resources we cannot go to OceanView every three weeks and more importantly it is important that we test that the application works in the network conditions in OceanView before going there to host the workshops to get feedback.

6.5 Data Analysis

At the end of the project, we will have metrics for both the simple and co-designed applications, including daily user engagement, feature interaction, and volume of krone transactions via the mobile application. These metrics will allow us to gauge the effectiveness of a co-designed application compared to one that is not. Additionally, we will analyze overall network data usage on the Inethi network, categorizing it into various usage categories. By comparing metrics at three points (before deployment of app version 1, after deployment of app version 1, and after deployment of app version 2) and examining the percentage of data attributed to mobile applications, we aim to assess the impact of application design on local service utilization and krone transactions in OceanView.

6.6 Software Development Methodology

6.6.1 Project Managment We will employ an Agile project management framework, specifically using Scrum methodology. This approach will involve regular sprints of three weeks, allowing for flexible adjustments to plans based on ongoing feedback and iterative progress. Prosper will be the

Product Owner, Takunda will be the Scrum Master, Reabetsoe, Prosper and Takunda will be the development team. We understand that our short sprints may risk burnout, but since our focus is on gathering user feedback and crafting an application that closely aligns with user preferences, we opt for short sprints. This approach allows us to maximize feedback collection and collaboration with the community. Regular scrum meetings will ensure that obstacles are quickly identified.

6.6.2 Requirements Gathering The majority of the project requirements have been obtained through meetings with our supervisor and iNethi personnel. We will however use part of the first workshop to engage with the community to validate and refine the requirements.

6.6.3 Testing Essential equipment for this project include the iNethi Testbed ,which is a simulated environment set up on campus to replicate the network conditions of Ocean View. This setup allows us to test the application under similar conditions to those it will encounter in its actual usage environment, ensuring it functions properly before deployment. Using the iNethi Testbed is essential as we cannot always access Ocean View directly for testing.

We will utilize React Testing to simulate user interactions, ensuring that navigation, data handling, and state management meet our standards. Pytest will be employed to conduct thorough tests on each function that interacts with the iNethi databases, safeguarding data integrity and security. To test our APIs, we will use Postman, and Selenium will play a key role in verifying the seamless integration of data flow between the frontend and backend. OWASP ZAP will be used to identify any vulnerabilities during the development phase.

6.6.4 Deployment For the deployment of the iNethi mobile application, Docker will be utilized to ensure consistent and scalable distribution across the iNethi network. This containerization strategy guarantees that the application operates uniformly across different environments, supporting easy scaling and secure isolation of operational instances. Integration with Radius Desk is critical for managing network authentication and tracking voucher usage effectively within the community network. This setup allows for detailed analytics on user behavior and resource access, facilitating optimized service delivery and robust security measures

7 ETHICAL, PROFESSIONAL AND LEGAL ISSUES

7.1 Ethics Clearance

Throughout our project, we will maintain ethical standards by obtaining ethical clearance from the University of Cape Town's Human Research Ethics Committee. All participants will be thoroughly informed about the research objectives and their rights, including the freedom to withdraw at any time without repercussions. We will inform users of our app about the tracking of their app usage and patterns and obtain their explicit consent before utilizing any data collected from this tracking process. This ensures transparency and respect for user privacy, aligning with ethical standards regarding data collection and usage. Our initiative adheres to the Information and Communication Technologies for Development (ICTD) ethical standards, advocating for inclusivity, fairness, and respect for the cultural, social, and economic contexts of participants. We are committed to empowering the Ocean View community by aligning our technological solutions with their actual needs.

7.2 Trust Code

Additionally, our project aligns with the TRUST Principles for digital content preservation, emphasizing Transparency, Responsibility, User focus, Sustainability, and Technology. We will manage data transparently, ensure that our software is user-friendly, meets the needs of the community, and uses technology sustainably and ethically.

The InethiApp will be open-sourced under a BSD-style license, promoting a high degree of freedom in using, modifying, and redistributing the code, thus supporting community development and enabling other developers to adapt the software to similar contexts with minimal restrictions.

We will utilize libraries that are also open-sourced, such as React for the front end, which are maintainable and compatible with BSD-style licensing. The development team will adhere to high standards of coding and documentation, following industry best practices to write clean, maintainable code and maintain comprehensive documentation to facilitate future enhancements and ensure the project's longevity.

8 ANTICIPATED OUTCOMES

8.1 Expected Impact

Currently, the iNethi network provides services through a splash page that users access via a web browser when they connect. However, this setup has limitations: community usage is low, and users often struggle to remember the URLs needed to access specific content. Additionally, there's no functionality for offline interaction with services or for downloading content to use when not connected to the network.

Our project aims to enhance the user experience and increase engagement with the iNethi network. By the end of the project, we expect a significant rise in the number of users connected to iNethi, as well as an increase in the usage of the services it offers. We anticipate more users will purchase and utilize iNethi vouchers, leading to greater use of the local services available on the network and more frequent use of the community wallet. These improvements will come from replacing the basic app with a more sophisticated

and user-friendly version developed based on community feedback.

We anticipate that the new application will significantly enhance visibility regarding how and when users connect to the network. Upon completion, the app will allow users to easily check their connectivity status within the iNethi community network, indicating whether they are connected to iNethi or using their own data. This feature is especially beneficial for those with limited data, as it enables efficient monitoring and management of data usage.

Additionally, the application will include a detailed map pinpointing specific locations within the Ocean View community where users can connect to the mesh network. This map not only improves visibility but also supports users who have limited bandwidth or are situated far from network nodes. It allows them to download necessary content from available services and precisely locate network devices, ensuring they can maximize their access to the network regardless of their physical location.

Moreover, the application will eliminate the need for users to remember URLs. Instead, users can simply click on icons related to the services offered by the iNethi network, and download content to access later, even when offline.

These enhancements are expected to significantly improve user engagement and increase the reach and impact of the iNethi network, ensuring that more community members benefit from its services, regardless of their connectivity status.

8.2 Key Success Factors

The application will be regarded as successful if it is developed on schedule, completed, and deployed into the Ocean View community by the end of July. This will allow for ongoing refinement based on workshop feedback. Key indicators of success are, increased engagement and utilization of the iNethi Community Network, more frequent purchases of network vouchers, and greater usage of whitelisted applications. The broader adoption and usage of the application will demonstrate its effectiveness in engaging users with iNethi's services and the network overall.

8.3 System

For this project, we aim to develop the project according to the requirements of the community as they will be the ones using the application. The App will be built to be robust and scalable software platform designed to ensure reliable service even in low-connectivity environments. Local caching will be used to provide online functionality, ensuring that users can access key features even without an active internet connection. Key Features

- Offline Access: The app is designed to function offline, allowing users to download and interact with content such as educational materials without an internet connection.
- Digital Wallet: Integrates a secure digital wallet that enables users to perform transactions using a community voucher. This feature facilitates local commerce and helps integrate financial services into the community network.
- Service Integration: Seamlessly connects to local services including community radio, Wikipedia, TED Talks, Khan Academy, and more, providing a central hub for educational and entertainment resources.
- Navigation and Mapping: Includes a mapping feature that guides users to various mesh network access points within the Ocean View community, enhancing the user's ability to connect to the network efficiently.
- Data Voucher Management: Allows users to monitor their data vouchers directly through the application.

9 Major Design Challenges Overcome

- Integration of Diverse Services: Integrating various services into a single platform poses a challenge in maintaining seamless performance across different modules. This can be managed through careful architectural design and ensuring that each service can operate independently without affecting the functionality of others.
- Network Variability and Connectivity: A major challenge is designing an application that remains functional across varying network strengths. We plan to address this by optimizing the application for low bandwidth conditions and implementing extensive offline capabilities to ensure it can function even when connectivity is limited.
- User Interface (UI) Accessibility: It is crucial to ensure that the application is accessible to all community members, regardless of their tech-savviness. We plan on designing the UI to be intuitive and user-friendly, incorporating visual aids and simple navigation to accommodate users with varying levels of digital literacy.
- Security Concerns: creating a secure digital wallet is also a challenge as we must protect the users' personal and financial information. We plan on using strong encryption and frequently test the application to ensure it doesn't have any security vulnerabilities.
- Integration of Diverse Services: Integrating a variety of services into a single platform poses a challenge in maintaining seamless performance across different modules. We plan to manage this through careful architectural design, ensuring that each service can

operate independently without affecting the functionality of others.
- Scalability: Anticipating future growth, the system is being designed to be highly scalable. We are approaching this challenge using a modular architecture that allows for easy updates and the addition of new features without disrupting existing services.

10 Project Plan

10.1 Risks

The risks associated with the project are outlined and detailed in the table located in Appendix A. The table also discusses the strategies for mitigation, monitoring, and management of these risks.

10.2 Timeline

The table on appendix C provides a summary of key phases in the project timeline . For a detailed timeline of the project, please see Appendix B.

10.3 Resources Required

The successful development of the software is deeply dependent on the active participation of the Ocean View community members. Their involvement is critical to understanding their needs and ensuring the user experience is tailored to their diverse technical backgrounds. Additionally, the project requires a dedicated team consisting of a Product Owner, Scrum Master, and development team members. These individuals are responsible for tasks such as service integration, digital wallet development, creating detailed maps, and maintaining the software, which are essential for the project's success

Essential equipment for this project includes the iNethi testbed located at UCT upper campus, which is crucial for assessing the application's compatibility with the iNethi network. For software development, we will utilize React Testing to simulate user interactions, ensuring that navigation, data handling, and state management meet our standards. Pytest will be employed to conduct thorough tests on each function that interacts with the iNethi databases, safeguarding data integrity and security.

To test our APIs, we will use Postman, and Selenium will play a key role in verifying the seamless integration of data flow between the frontend and backend. OWASP ZAP will be used to identify any vulnerabilities during the development phase. Docker will facilitate the deployment of the application across the iNethi network. Additionally, we will leverage existing services like Radius Desk integrated into the iNethi network architecture to manage and track voucher usage effectively.

10.4 Deliverables

The table on Appendix D show all the deliverables.

10.5 Milestones

The table on appendix E presents the milestones for the project, which include development milestones and workshops. For more detailed information on these milestones, please refer to the Gantt chart in Appendix B.

10.6 Work Allocation

10.6.1 Software Development Takunda will oversee the integration of all services accessible via the iNethi Community network into the mobile application. He will focus on developing features that enable users to download content and access it offline from the iNethi Community Network. Reabetsoe will lead the development of the digital wallet user interface, specifically designed for facilitating community voucher transactions within the Ocean View community. Prosper will be tasked with creating a detailed map to direct users to specific locations in the Ocean View community where they can connect to the mesh network. Additionally, he will develop a notification feature to update users on their connection status to the iNethi community network and enable them to monitor their voucher usage, enhancing access to network services and connectivity.

10.6.2 Workshops Throughout the workshops, all team members will be present, each taking turns leading and planning sessions. Takunda will lead the first and second workshops, focusing on gathering user feedback to identify necessary services and improve the app experience. Reabetsoe will conduct and facilitate the third workshop, evaluating the impact and utility of the digital wallet. Prosper will take charge of running the final workshop, ensuring the project's objectives are met and concluding the engagement with the community.

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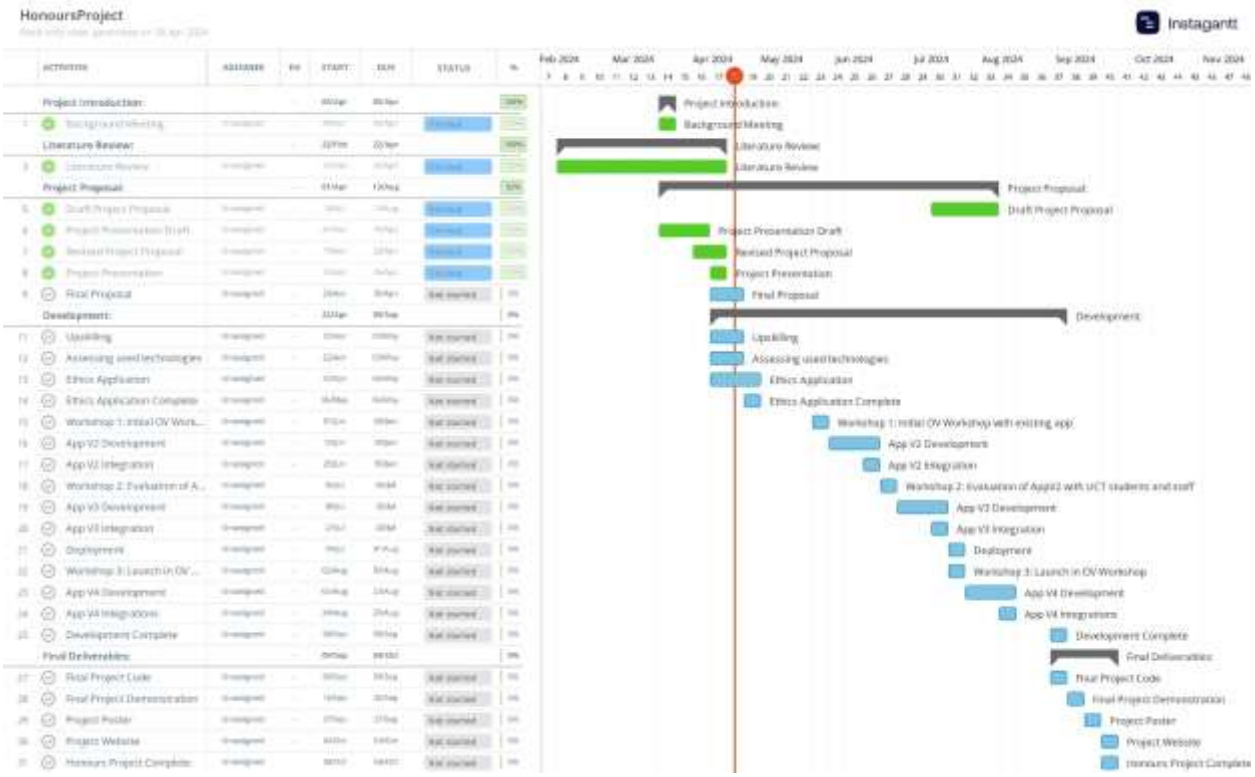
Appendix A

Risks	Probability	Impact	Consequence	Mitigation	Monitoring	Management
Lack of Community Engagement	High	High	Lack of user Involvement can lead to mismatch between the application features and the actual user needs	Develop a strong engagement strategy that includes regular workshops, feedback sessions, and incentives for participation	Track engagement metrics and feedback quality.	Adapt engagement strategies based on ongoing feedback and community interest levels.
Technical Integration Challenges	Medium	High	Difficulties in integrating various services and platforms could lead to functionality issues or delays.	Utilize a modular architecture and ensure robust testing environments . Involve technical experts early in the planning stages.	Regular integration tests and development updates	Leverage technical expertise and potentially increase resource allocation to address integration challenges promptly.
Technical Knowledge Gaps	Medium	Mediu m	Lack of necessary technical skills could delay development and impact the quality of the application.	consult with technical advisors of Inethi necessary.	Regular skill assessments and project milestone reviews.	Adjust team composition or provide additional training to address skill gaps.
Poor Time Managemen t Leading to Incomplete Software Deliverable s	Low	Mediu m	Inadequate time management could result in unfinished software components, affecting the success of the project	Adhere strictly to the project schedule or timeline. Begin tasks as early as possible to avoid last-	Regularly review the project timeline to track upcoming milestones and deliverables.	If falling behind, prioritize essential features and consider scaling back the project scope to manageable dimensions

			and potentially impacting the completion of the honours year.	minute rushes.		
Creating unrealistic project expectations within community	Medium	High	Setting unrealistic project expectations can lead to the loss of trust of community members	Establish clear, achievable goals through collaborative planning with all stakeholders. Regularly communicate the scope, potential challenges, and realistic outcomes to all involved parties.	Engage with stakeholders through continuous feedback loops to gauge their expectations and perceptions of the project progress.	Adjust communications and project deliverables in response to feedback to align expectations with current project realities. Educate stakeholders on the technical and practical constraints that impact project outcomes.
Project Partner Leave	Low	High	Some features of the system might not be developed, can lead to increased workload for the remaining teammates and can lead to possible delays.	Minimize dependencies by ensuring that knowledge and responsibilities are shared among all team members. Cross-train partners on various aspects of the project to ensure that everyone has a basic understanding of all components.	Maintain regular communication among team members to assess their commitment and any potential changes that might affect their continued involvement.	If a partner does leave, reassess the project scope and resource allocation to accommodate the reduced capacity. Consider recruiting a new team member if necessary to fill the critical skills gap.

Loss or corruption of source code	Low	High	Loss or corruption of the source code could significantly delay the project, requiring developers to recreate lost work and potentially impacting the overall quality and functionality of the application.	Implement robust version control systems like Git to manage and track changes in the source code. Ensure regular backups of the source code are taken and stored in multiple secure locations.	Regularly review backup procedures and version control logs to ensure that they are functioning correctly and that backups are up to date.	In the event of loss or corruption, use the most recent backup to restore the source code. Evaluate and strengthen security measures and backup procedures to prevent future occurrences.

Appendix B



Appendix C

Task	Period
Upskilling and Assessing Existing Technologies	22 April - 03 May
Assessing used technologies	22 April - 03 May
Workshop 1: initial OV workshop with existing app	07 June – 08 June
App V2 Development	10 June – 28 June
App V2 Integration	29 June – 30 June
Workshop 2: Workshop 2: Evaluation of AppV2 with UCT students and staff	05 July – 06 July
App V3 Development	08 July – 26 July
App V3 Integration	27 July – 28 July
Deployment	29 July – 1 August
Workshop 3: launch in OV workshop	02 August – 03 August
App V4 Development	05 August – 23 August
App V4 Integration	24 August – 25 August
Development Complete	09 September – 09 September

Appendix D

Deliverable	Due Date
Project Proposal	22 April
Project Proposal Presentations	22 April - 25 April
Revised Project Proposal	30 April
Ethics Application	06 May
Project Progress Demonstration	22 July - 26 July
Draft of final paper	23 August
Final Report	30 August
Final Code	09 September
Final Project Demonstration	16 September - 20 September
Poster	7 September
Website	4 October
School of IT Showcase	22 October

Appendix E

Milestone	Date
Upskilling	03 May
Completion of preliminary technology assessment	03 May
Workshop 1: initial OV workshop with existing app	07 June – 08 June

App V2 Development	10 June – 28 June
App V2 Integration	29 June – 30 June
Workshop 2: Evaluation of AppV2 with UCT students and staff	05 July – 06 July
App V3 Development	08 July – 26 July
App V3 Integration	27 July – 28 July
Initial deployment of the app to a community subset	29 July – 01 August
Workshop 3: launch in OV workshop	02 August – 03 August
App V4 Development	05 August – 23 August
App V4 Integration	24 August – 25 August
Project closure and review	09 September
Presentation at the School of IT Showcase	22 October

HonoursProject

Read-only view, generated on 30 Apr 2024

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	ACTIVITIES	ASSIGNEE	EH	START	DUE	STATUS	%
	Project Introduction:		-	05/Apr	05/Apr		100%
1	Background Meeting	Unassigned	-	05/Apr	05/Apr	Finished	100%
	Literature Review:		-	22/Feb	22/Apr		100%
3	Literature Review	Unassigned	-	22/Feb	22/Apr	Finished	100%
	Project Proposal:		-	01/Apr	13/Aug		92%
5	Draft Project Proposal	Unassigned	-	25/Jul	13/Aug	Finished	100%
6	Project Presentation Draft	Unassigned	-	01/Apr	19/Apr	Finished	100%
7	Revised Project Proposal	Unassigned	-	19/Apr	22/Apr	Finished	100%
8	Project Presentation	Unassigned	-	23/Apr	26/Apr	Finished	100%
9	Final Proposal	Unassigned	-	26/Apr	30/Apr	Not started	0%
	Development:		-	22/Apr	09/Sep		0%
11	Upskilling	Unassigned	-	22/Apr	03/May	Not started	0%
12	Assessing used technologies	Unassigned	-	22/Apr	03/May	Not started	0%
13	Ethics Application	Unassigned	-	22/Apr	06/May	Not started	0%
14	Ethics Application Complete	Unassigned	-	06/May	06/May	Not started	0%
15	Workshop 1: Initial OV Work...	Unassigned	-	07/Jun	08/Jun	Not started	0%
16	App V2 Development	Unassigned	-	10/Jun	28/Jun	Not started	0%
17	App V2 Integration	Unassigned	-	29/Jun	30/Jun	Not started	0%
18	Workshop 2: Evaluation of A...	Unassigned	-	05/Jul	06/Jul	Not started	0%
19	App V3 Development	Unassigned	-	08/Jul	26/Jul	Not started	0%
20	App V3 Integration	Unassigned	-	27/Jul	28/Jul	Not started	0%
21	Deployment	Unassigned	-	29/Jul	01/Aug	Not started	0%
22	Workshop 3: Launch in OV ...	Unassigned	-	02/Aug	03/Aug	Not started	0%
23	App V4 Development	Unassigned	-	05/Aug	23/Aug	Not started	0%
24	App V4 Integrations	Unassigned	-	24/Aug	25/Aug	Not started	0%
25	Development Complete	Unassigned	-	09/Sep	09/Sep	Not started	0%
	Final Deliverables:		-	09/Sep	04/Oct		0%
27	Final Project Code	Unassigned	-	09/Sep	09/Sep	Not started	0%
28	Final Project Demonstration	Unassigned	-	16/Sep	20/Sep	Not started	0%
29	Project Poster	Unassigned	-	27/Sep	27/Sep	Not started	0%
30	Project Website	Unassigned	-	04/Oct	04/Oct	Not started	0%
31	Honours Project Complete	Unassigned	-	04/Oct	04/Oct	Not started	0%