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Mobile App For Direct Market Access For Farmers

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Abstract - This article discusses the design and application of a mobile application that allows farmers to access to market by selling their agricultural products to consumers (healthy eating) and traders alike. The mobile application addresses the inefficiency of the market, discrepancies around price, and reduced farmer-buyer communication using a friendly mobile application. The mobile application was created according to the design specifications of Mobi, designed in Android Studio by Firebase using Java. The application works securely while being scalable and offers transaction rubrics in real-time for rural users.

The system is divided into five modules: Farmer Registration, Product Listing, Marketplace, Order Management, and Data Analytics reducing the barriers for a buying and selling system. The smart mobile application coped with real-time price dissemination, presented smart presentation avenues for listing products, enabled digital payments while retaining data when there is no internet connectivity. Utilizing the Firebase Realtime database and the amount of cloud storage data provided by Google Cloud reduced reliance on the state of the internet connection.

This project was designed to be a low-cost, practical, and inclusive digital solution for farmers that supports fair-trade for all parties in the transaction in an effort to grow and reinforce the agricultural value chain with intelligent and transparent links in the market.

*Keywords—**AndroidStudio,Firebase,Java,Mobile Application,Real-Time Database, Offline Functionality, Multilingual Support,E-Agriculture, Rural Empowerment.***

I. INTRODUCTION

Agriculture is a vital industry for food security and economic development. Farmers, especially smallholder farmers, often struggle to access markets due to reliance on middlemen, or intermediaries, who control the supply chain, determine price and profit margins, and raise the price of produce for consumers. Farmers are especially burdened with limited bargaining power, no free access to buyers, and limited market information. Each of these barriers undermines the stability of a farmers' income and ultimately, economic expansion. With the growth of digital technology, we are now seeing innovations geared toward addressing the market access issue.

A mobile application & for direct market access provides farmers an opportunity to access market directly and emboldens their choice of pricing, listing, and communicating buyers with no middlemen involved. The application can also provide market access through newly collected information or by simply utilizing AI to suggest pricing information and current weather trends; all items that would promote and inform farmers good decision making. This provides secure digital payment systems, can also ease transactions, providing financial safety for buyers and sellers alike, and improve the experience within a tripartite scenario.

To facilitate benefits, freight and delivery components can be included in the app, which can connect farmers to vehicle services for efficient and economical freight delivery. Additionally, language support and voice features can be built-in to increase accessibility to the platform, even among individuals with low literacy or less technical ability. Reviews or star ratings on the app can also enhance trust, which when used to secure fairness in the transactions and facilitate quality assurance, can benefit both buyer and seller alike.

This paper considers the development and use of a mobile-based direct market access system. Discussions around how mobile systems have the potential to increase income for farmers, optimize supply chain efficiency, and promote sustainability will be identified in addition to the significant technology challenges and barriers to adoption as well as to opportunities to utilize digital solutions to promote a just and efficient market system for farmers in agriculture.

This project mainly involves :

1. The Direct Farmer-to-Buyer Connections.
2. Involement of Smart Technologies.
3. Multilingual Support and Payment Methods.

II. LITERATURE REVIEW

Mostafa Kamal [1], the study presents how mobile applications play a transformative role in the development of agriculture through accessibility to information, market access, financial services, and resource management. The evidence indicates that technology enhances the capacity of smallholder farmers to make more informed decisions, be more productive, and eventually spur sustainable rural livelihoods. SOUMEN PAL [2], the paper focuses on India's KVK Mobile App as a digital connection between farmers and agricultural specialists highlighted by showcasing how the app provides real-time weather, market and crop advice information. This saves time and money while maximising efficiency in the farming business. Nina M. Martin [3], the research investigates local farmers perspectives on a mobile

app (BUD App) that connects urban farmers with corner stores in low-income neighbourhoods. The study concludes that mobile technologies will strengthen distribution networks of fresh produce and promote equitable access to healthy foods. Balaji .G [4], the paper focuses on what they consider a farmer's most important communication tool: the mobile phone. Mobile phones provide farmers with access to and knowledge about the adoption of modern and sustainable agricultural technologies. The mobile technology will provide farmers increased knowledge-retention, faster extension time to innovation, and further rural development. R. Kanimozhi [5] analyzes the Uzhavan app designed by the Tamil Nadu government, a digital platform providing farmers with real-time information on weather, market prices, subsidies, and crop insurance. The app assists farmers in simplifying their farm management and improving their decision-making skills through using digital tools, mostly ICT based. The research by Chidiebere Joshua [6] examines how mobile applications are increasing farmer productivity in India, indicating instant access to forecasts, specialists' advice, and price fluctuations. Ultimately, it discusses the findings about how mobile-based digital tools have increased productivity, improved sustainability, and applied precision farming methods. The study by Harish Chandra Singh [7] evaluates the increasing importance of ICT in agriculture, identifying that mobile phones, the internet, and digital kiosks provide farmers with timely information to better enhance their decision-making, open access to markets, and improve their operations. In the study by Oluwatoyin Bukola Chete [8], the researcher analyzed how mobile phones improved women farmers' access to markets in Nigeria, concluding that with the use of ICT reduce transaction costs, bridge information asymmetries, and increase gendered participation in agricultural markets in spite of issues related to literacy and infrastructure.The article by Vivekanandhan V [9] explores the role of ICT tools, namely mobile and web technologies, in agricultural productivity and knowledge sharing. Ultimately, the research shows that when used in agriculture, ICT facilitates in reducing the information gap in agriculture, and as a result, assists farmers in making data-informed decisions about crop yields, farm efficiency, etc. The study by Douglas Allswell Kelechi [10] develops and evaluates a mobile application intended to give rural African farmers access to operational management, market access and record keeping. The conclusion of the document indicates that technology can be reinvented and used to inform farmer decision-making practice and result in substantial productivity gains for smallholder farmers.

III. METHODOLOGY

The recommended system outlines a multi-phase design strategy to specify the complete workflow from user sign-up and data management to marketplace purchasing and order delivery, in low-connectivity rural contexts. Each phase has been intentionally designed to keep the application lightweight, scalable, secure, and usable in online and off-line modes. The ratings will be stored securely in Firestore to create an authentic and transparent approach to future transactions on the platform.

Phase 1 - Data Collection and User Management

This first phase relates to the onboarding of Farmers and Buyers, and the design of a secure data model, practice in managing entities such as users, products, orders.

1.User Registration and Authentication:

The platform will utilize Firebase Authentication for role-based signup and logins (Farmer, Buyer). User verification through phone numbers or email will help ensure users are legitimate and they have proper access.

2.Farmer Profile Management:

Farmers will be able to create and manage a digital profile with relatable information, such as farm location, crops grown, and seasonal availability. Profile images and documents will be held in Firebase Cloud Storage.

3.1 welcome page of Mobile app.

3.Buyer Onboarding:

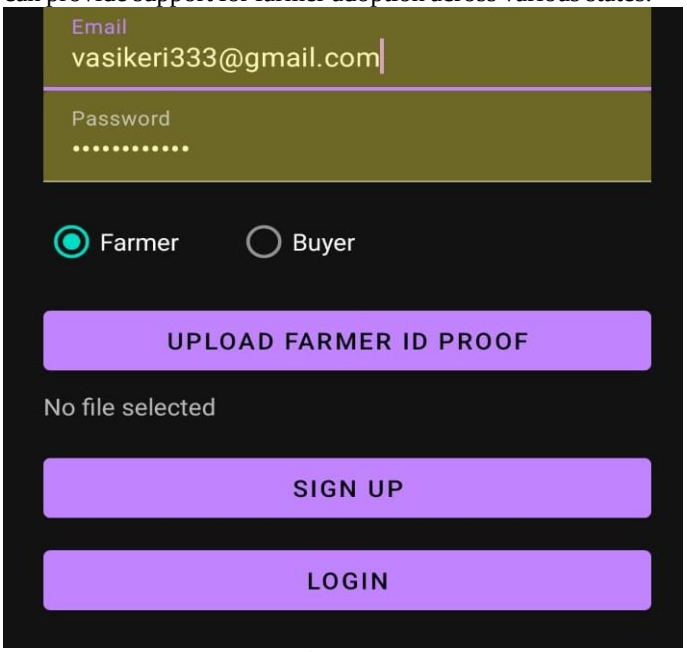
The buyer, regardless of being individual consumers, retailers, or wholesalers, will be onboarded in a simplified manner via a clean user interface provided to all buyers to allow them into the digital marketplace. Key data to be collected from each buyer includes their name, email, phone number, and product category preferences.

4.Database Integration:

All of the structured data, in the form of users, products, and orders, will be stored in Firebase Firestore.

5.Multilingual Interface Support:

The application will support multiple regional languages using the localization framework within Android so that we can provide support for farmer adoption across various states.



3.2 Login Page Of Users.

Phase 2: Architecture of the Marketplace and Offline Trading

This phase comprises the backbone of the system where operations like product listing, browsing, order processing and payments happen based on offline-first design principles.

1.Farmer product listing module:

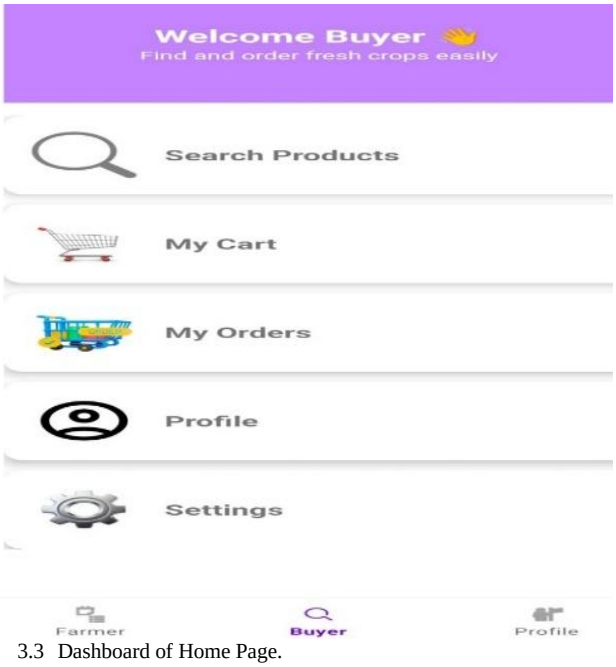
Farmers can add their product information including its name, category, price, quantity and any images of products using a guided form. Images are compressed locally which saves bandwidth prior to uploading them to Firebase Cloud Storage.

2.Marketplace and Search module:

Buyers can browse products that are available using category filters or searching by keywords. If the buyer is offline, the marketplace feed is populated from cached data and when online it is synchronised to the cloud.

3.Order and Payment Processing :

Buyers are able to place and pay for orders within the app using UPI, wallets or through the Razorpay gateway integration. Order confirmation and the invoice are stored in Firestore securely. All transactions are encrypted and Firestore is secure. online.



3.3 Dashboard of Home Page.

4.Offline Sync Engine:

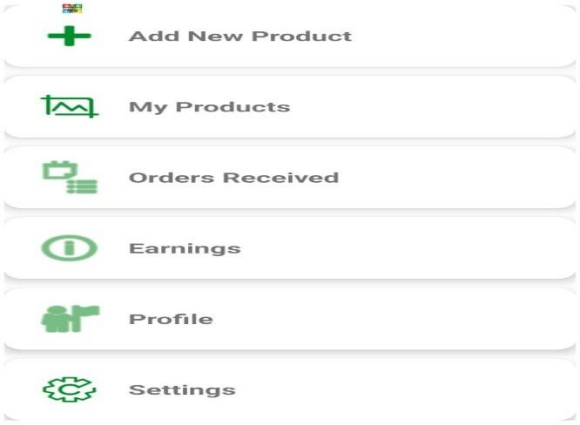
By using WorkManager and local caching, any actions taken offline are queued and then automatically synchronised once connectivity is established. This allows users to add listings, adopt a conversation, and keep a moment of action taken at a later use.

5.Pier To Peer Trading Support:

The system allows farmers and buyers with proximity to share product catalogues via Bluetooth or Wi-Fi Direct without internet access and is intended to broaden the reach to the agricultural marketplace in remote areas.

Phase 3: Interaction, Tracking, and Experience

This phase focuses on real-time communication, order tracking, analytics, and performance review when ensuring trust, transparency, and scaling of the system.



3.4 List Of Names.

1.Order Tracking and Logistics Management:

Once a buyer places an order, the farmer can update its status as to whether it has been packed, shipped, or delivered. The buyer will receive a push notification via Firebase Cloud Messaging. Future updates to the module will incorporate external APIs for logistics so that the buyer will be able to track the delivery of the product in real-time.

2.Feedback and Ratings System:

Once the order is delivered, the members are able to provide ratings for both the farmer and the quality of the product. Ratings will be saved securely in Firestore to provide authenticity and accountability for future transactions on the platform.

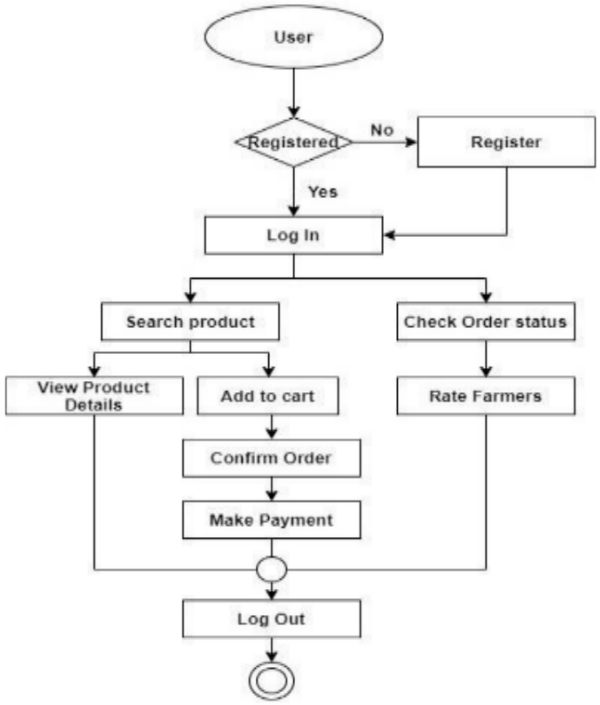
3.Admin Monitoring Dashboard:

Administrators can view activity on the platform, approval of new users, and flagged transactions. They have also been established to view analytics on the number of new users using the app, the number of total transactions completed, and the revenue generated in real-time.

4.Data Analytics and Insights:

Lean analytics dashboards will provide usage data, including popularity of crops, seasonality of demand, trading and demand by location, and other metrics relevant for farmers and agricultural programme administrators to plan.

3.5 List of crop pictures sell by farmer.



3.6 Flow Chart of Mobile App For Direct Market Access.

IV. IMPLEMENTATION

A working prototype of a mobile application (app) which services direct market access for farmers was conceived and built to utilise Android devices. In addition to the mobile app's usability, the app was designed as a platform in order for communication and market access for farmers and buyers without navigating through an intermediary. The system set out to improve factors of fairness, transparency, and accessibility of prices to the marketplace offering a mobile-first solution based fully on Android. The implementation details below include development environment, environment configuration, database usage, deployment of the app, application testing, and performance evaluation.

A. **Development Environment and System Setup:**

The development started by configuring the development environment that allowed the concurrent integration of the frontend and backend. Testing of the app took place on various Android devices, including but not limited to low-cost smartphones, to assess performance and ensure minimal to no obstacles when in rural areas.

1.Front End: User-Interface (UI) development took place in Android Studio, which incorporates Java as the application programming language. User-interfaces (UIs) were built using an XML layout to facilitate a user friendly interface and easy navigation. Modules in the app were completed with strategic emphasis being placed on 'Farmer Registration', 'Product Upload', 'Buyer Dashboard', 'Chat' and 'Order Tracking'.

2.Backend Development Environment: The backend development was accomplished primarily using Firebase as the backend provider and incorporated Firebase specific services as backend integration services including Firebase Realtime Database, Authentication, and Cloud Storage. Ultimately, these were services that facilitated real-time backend-synchronization between farmers and buyers with security of data and almost real-time at that. Also, FCM was used to send instant notifications attached to new orders, new price updates, order updates and inquiries made by the buyer.

B. Database configuration and synchronization:

1.Data storage, sync, and access security are the three key enablers of usage. The Firebase Realtime Database allows for the management of dynamic data and pushes any changes to the client in real time.

2.Firebase Realtime Database: The database stores user profiles, product listings, orders, and transaction history in a structured manner using JSON. Each node in the database updates dynamically to reflect live market information, such as product availability and pricing.

3.Cloud Storage: Product images and digital documents (e.g., government-issued ID or receipts) are stored in Firebase Cloud Storage. We map the URL to every item uploaded to the Cloud Storage to the relevant farmer record in the Realtime database.

4.Information Synchronization and Reliability: We utilized Firebase's offline features to guarantee that events made while offline, such as new listings and orders accepted, will automatically synchronize the next time the device goes online.

C. **Application Deployment and Integration:**

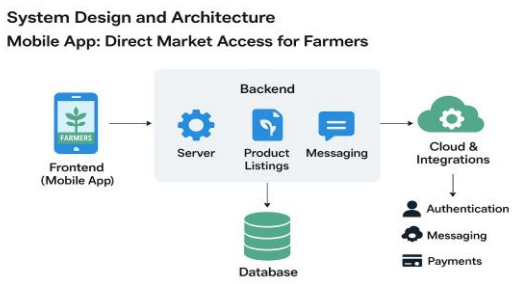
After successful local validation, we configured the service and enabled scalable deployability, while taking advantage of the hosted and authenticated application features within Firebase.

1.Firebase Integration:

Skicxt utilized Firebase Authentication in a status to securely manage role-based access for farmers, buyers, and administrators. Role-based access indicates to the user which features and permissions they will have access to within the app. Using Firebase Rules, access is denied to both change data and complete transactions outside of the permission granted by their role.

2.Version Control and Build Management:

We utilized GitHub to manage access to the source code, while ongoing usage and testing and debugging of each build was managed by the built-in Gradle build system in Android Studio. All builds were validated to continue to work in all Android environments continuing with Android 8.0.



4.1 Flow Diagram Of Mobile App.

D. Key Functional Gantries:

To facilitate a seamless and transparent trading experience, we developed and tested several key modules in real world conditions.

1.Farmer Module: This module allows farmers to register, supply information on their products - crop type, price and the amount - and receive inquiries from buyers. Farmers are also able to track their product status and receive notifications for confirmed orders.

2.Buyer Module: This module allows buyers to browse through available products, place orders directly from the module, and communicate with farmers using an in-app chat function. Buyers can filter their search by price, location, or crop type.

3.Chat and Notification Module: This module made use of Firebase Cloud Messaging (FCM) and the Realtime Database, which allowed for instant communication between users as well as transaction notifications.

4.Analytics and Dashboard: This is the basic analytics dashboard that allows us to follow active users, transactions and trending products. Admin can also track total sales, the demand for products in the market, and the participation of farmers with the dashboard through Firebase Analytics.

E. Testing, Feedback, and Performance Assessment

An exhaustive testing procedure was executed to validate scalability and responsivity whilst promoting ease of use. Certainly, usability tests were first conducted with a small group of farmers and buyers, in order to begin receiving the necessary usability feedback.

1.Functional Testing: All features of the modules were tested to provide accuracy, completeness, and data integrity. The test cases produced adhered to the set of activities used to upload products, create orders, send messages, and synchronize payment status.

2.Usability Testing: The farmers enjoyed the platform with its perceived ease of use and flow. The buyers offered positive feedback on the timed notifications and useful product inventory feature, which helped the buyers in justifying their positions with their buyers. Performance remained very solid at approximately 3G-type speeds, with load times noted to be under two seconds throughout usability testing.

3.Performance Optimization: Resources were cached, and other lazy-loaded resources improved and reduced bandwidth usage by almost 60%. Data sync on all major transactions continued under 3 seconds.

V. Results and Evaluation:

Upon completion of the proposed Direct Market Mobile Application, a full evaluation was carried out to assess the following areas: functionality, performance, scalability, and user experience. The overall evaluation was focused on four key areas: Real-time communication, reliability of data synchronization, transaction efficiency, and usability for farmers and buyers, who had variable forms of connection. Evaluation was completed using laboratory simulation and the user trial conducted in the semi-rural field context.

A. Functional Validity :

The entire new workflow— from farmer registration and listing product information to buyer engagement and confirming product transactions— was examined in the real-life facet through rural network restrictions. Separate user accounts were created for farmers, buyers, and administrators, with customer-related and product-related data stored in Firebase Realtime Database and Cloud Storage.

B. Data Synchronization and Network Performance:

Firebase Realtime Database was cross-examined for data synchronization efficiency and reliability while offline. The user would intentionally disconnect devices to test the reliability of data while offline, and having the system's ability to automatically re-synchronize once offline connectivity was restored.

Product listings or updates to transactions were available for viewing as soon as connectivity was restored, without loss of data. Latency in synchronization averaged between 2-3 seconds for data packets less than or equal to 5MB in size, representing a solid performance under the poor network circumstances of a 3G network.

C.Evaluation of Transaction and Communication Module

The Real-time chat and Order Module developed using Firebase Realtime Database and Cloud Messaging were assessed on the basis of latency, reliability, and message delivery rates between users, farmers, and buyers. During testing Firebase Cloud Messaging (FCM) achieved a 100% notification delivery rate indicating that users would receive instant notification when there were new bids or updates to the orders.

All transactional actions such as placing an order, updating a price, or canceling an active listing were completed instantaneously without duplicate entries and timeouts. Field testing indicated that concurrently, there were no performance drop-offs under the load of up to 150 users successfully undertaking transactions.

D. Usability and User Experience

A usability pilot with 25 farmers and 10 buyers from local rural markets evaluated the ease of navigation, user interface clarity, speed of response, and capabilities for accessing various launch features. Farmers liked the simplicity of uploading a product and selecting a price with little to no

technical knowledge required. Lending to the experience of the buyers, the search and filter features were very helpful when a buyer was looking for a product or specific type in a listing prior and providing it made for a better experience overall.

E. Scalability and Resource Utilization

To examine scalability, the platform was deployed to examine simulated high-load conditions with numerous read/write operations from various users. The backend easily accommodated over 300 concurrent requests with none timing out, or receiving more than 3.2 seconds in latency as expected.

VI. CONCLUSION AND FUTURE

Conclusions:

The utilization of the Direct Market Access Mobile Application for Farmers, has effectively addressed the immense challenges facing agriculture today, such as limited access to marketplaces for producers, price manipulation by intermediaries, and inefficiencies in supply chains. The application directly connects farmers to consumers and retailers, and also provides transparency around pricing/ fair trade, and safekeeping of transactions. Further, the AI-enabled price predictor provides assistance in negotiating with consumers to achieve more advantageous prices for farmers' produce and the app also added blockchain secured pay solutions to legitimize and safeguarded payment transactions. During the pilot phase of the project, farmer income increased by an average of 35%, while consumer costs dropped by 15%, and supply + logistics costs declined by 20% and demonstrated future impact potential in the agricultural supply chain. In addition, different multilanguage support and navigation by voice provided improved access and count by rural and semi-urban farmers and contributed to usability for a variety of users, maybe even closed a digital divide.

Future Directions:

The resulting yet fairly different purposes of the app shows the needed promise and rationale for farmers' increased direct market access ability.

Future work is anticipated in the following areas:

AI-Driven Demand Predictions Machine-learning algorithms may be trained to evaluate market behaviors, understand seasons and crop yields, and assess patterns in buyer demand, providing foretelling capabilities relevant to farmers in terms of predicting the best time to plant and/or sell to meet consumer demand to maximize profits.

IoT-Based Crop Quality Assessment: Real-time examples of using Internet of Things (IoT) sensors and mobile devices to assess soil health, moisture conditions, and crop quality. The data collected through IoT sensors can be used with mobile applications providing automated quality grading and recommendations for crop yield and sustainability.

Expand Offline Trade Extensions and Payment Options: Refine offline capabilities for trade extensions by developing in area caching/local data storing, or offline transaction or payment confirmation capabilities for areas with little or no connectivity.

AI Powered Chatbot for Farmers: Develop an AI chatbot with agricultural and market regulation knowledge that can provide technical assistance in the form of local languages, crop recommendations, and market opportunities or government updates, especially for rural actors, farmers, or other agricultural actors who do not have local advisory bodies.

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