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Mobile App for Direct Market Access for Farmers

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Abstract - AgroMart aims to close the gap between farmers and buyers by offering direct market access, removing middlemen, and offering real-time price transparency. The platform utilizes cutting-edge technologies, such as React Native for the front end, Node.js and Express.js for the back end, and MongoDB for the database. The platform's major features are real-time price data from government APIs, product listings, WhatsApp-enabled direct communication between buyers and sellers, and JWT-based secure authentication. The platform also offers digital payment gateways and recommends supporting AI-based crop identification and sentiment analysis in future releases. AgroMart offers a transparent and scalable Agri-commerce ecosystem, improves the buying experience for buyers, and empowers farmers with greater pricing control.

***Key Words*:** Real-time pricing, JWT authentication, Agri tech platform, mobile marketplace, AI in farming, digital agriculture, and direct trade.

1.INTRODUCTION

Agriculture remains the backbone of the world economy, particularly in emerging economies like India, where the majority of the population still depends on agriculture as the primary source of livelihood. Although a major driver of GDP, food security, and employment, the industry is afflicted with systemic inefficiencies, the most significant being supply and distribution chains. Middlemen and the unavailability of farmers' access to markets are two of the most critical challenges confronting Indian agriculture.

Most rural farm workers are marginal and small farmers, who sell their produce in the government-controlled wholesale markets or mandis. The prices and availability in these markets are typically controlled by commission brokers, brokers, and wholesalers. Hence, the farmers receive much less than the fair market value of the crop, earning little profit, debt cycles, and economic insecurity.

In addition, as opposed to industries like finance or retail, which have embraced platforms that provide real-time data, online interactions, and direct customer access, the agricultural industry has trailed in embracing digital technologies. The gap between farmers and urban markets is additionally widened by the reality that they are mostly lacking in digital literacy, infrastructure access to e-commerce, and confidence in existing digital tools. The digital

revolution has left most small farmers behind due to the lack of real-time price data, secure payments, and user-friendly interfaces. AgroMart comes in here. It's an online platform that is seeking to revolutionize the experience of agricultural trading by eliminating middlemen and offering a direct link between consumers and producers. With there being more than enough smartphones in rural areas, it's a mobile application. Farmers can utilize AgroMart to: *They can simply post their products in terms of images and descriptions.

*They price themselves according to real-time market information they get via government APIs.

*With integrated voice calls and WhatsApp capabilities, you can communicate with customers directly.

*Get paid securely using an inbuilt electronic payment system that automatically issues invoices.

AgroMart is constructed on the foundation of a modular, cloud-based architecture consisting of:

*The front end is React Native, which provides cross-platform mobile compatibility.

*Express.js and Node.js for the server (server and API processing),

*MongoDB with its data storage flexibility,

*JWT authentication for safe login and session management

*Third-party contributions to add more functionality, like payment gateways, Nodemailer, WhatsApp API, and Cloudinary.

In addition to solving short-term transaction issues, AgroMart also looks to future scalability and smarts. To enable farmers to make informed data-driven decisions regarding price and inventory management, the platform will integrate AI-driven features like image-based crop recognition and market sentiment.

In short, AgroMart is a socio-technical innovation that tries to redefine Indian agricultural business by empowering farmers and making them digitally inclusive. It is not merely a mobile app. AgroMart aims to create a sustainable and profitable platform for consumers and farmers by emphasizing accessibility, transparency, and scalability.

2.RELATED WORK

Developing nations like India's agricultural sector have several enduring problems, including a lack of digital adoption, a reliance on middlemen, a lack of price transparency, and inefficiencies in supply chains. Numerous research and technology projects have attempted to solve these challenges throughout the years. The disparity between digital innovation and grassroots adoption, notably among smallholder farmers, continues to be large.

1. The Role of Intermediaries in Agriculture
Middlemen in agricultural trade have consistently been shown in studies to have a detrimental economic effect. According to the Tory Commission Report (2007) and Singh et al. (2018), intermediaries frequently take a large share—up to 45%—of the income generated by farmers, leaving the producers with little profit. These middlemen frequently influence trade dynamics to their benefit and have control over both pricing and access to wholesale marketplaces. Small-scale farmers, who have little negotiating leverage and alternative market options, are particularly hurt by this scenario.

2. e-commerce in agriculture

Despite the revolution in sectors like retail and logistics due to e-commerce, there has been little integration in agriculture. BigBasket, Amazon Fresh, and Alibaba are examples of platforms that mostly cater to large-scale producers or business suppliers. The failure of small farmers to participate in these platforms has been attributed by Joshi and Mehta (2019) to poor digital literacy, a lack of user-friendly interfaces, and a lack of services targeted at rural areas. Even though these platforms have the infrastructure to connect purchasers and sellers, they are not made to meet the specific requirements of rural farmers in India.

3. Current AgriTech Platforms

India has seen the rise of AgriTech businesses like Bijak, AgroStar, DeHaat, and KrishiHub, which offer a variety of services such weather updates, advice, and input supply logistics. Although they provide helpful agricultural material, they typically lack marketplaces that are integrated and transaction oriented. The majority lack the tools for end-to-end sales, and some rely on manual coordination, which restricts the scalability and usability of direct-to-consumer models. Additionally, they frequently lack safe payment options and real-time price comparisons.

4. Real-time Market Data

Farmers must have real-time market data to make informed pricing decisions. Integrating government APIs for price data may help farmers shift away from unfair pricing models, according to Molla et al. (2020). But current platforms have difficulty displaying this data in a format that is useful for consumers who are not proficient in technology. Farmers lack access to basic dashboards or visualization tools that may help them comprehend trends and make informed judgments.

5. Integration of Digital Payment in Rural Agri Commerce

While digital payments have been made possible in rural regions by platforms like Paytm, Airtel Payments Bank, and MPesa, integration with agricultural platforms remains fragmented. According to Kumar and Sharma (2020), the use of these payment systems in Agri commerce ecosystems is restricted by trust concerns, internet connectivity issues, and a lack of farmer-specific interfaces, even though they provide security and traceability. The majority of rural farmers still deal in cash, which restricts financial openness and raises the possibility of theft, late payments, and fraud.

6. Data-driven and AI agriculture

Artificial intelligence, machine learning, and analytics are used more and more in modern agricultural innovation to enhance production, anticipate trends, and control inventories. Nevertheless, only a small number of platforms have been able to effectively integrate AI technologies into rural agricultural settings. Most agricultural technology tools are still manual or semi-automated, and they lack tailored insights based on crop type, geography, or seasonality.

Gap Discovered

Despite the existence of several digital programs, there is still no full, integrated mobile platform that allows small farmers direct access to consumers, real-time pricing information, safe digital payments, and communication capabilities. Additionally, the majority of platforms do not account for low levels of digital literacy and do not offer the flexibility necessary for future AI integration.

AgroMart bridges these gaps by:

*Offering a user-friendly mobile application with streamlined navigation.

*Providing up-to-date market values directly from government APIs.

*Facilitating direct communication between buyers and sellers via WhatsApp and telephone.

*Integrating safe digital payment gateways.

*Preparing for AI-powered capabilities such market mood analysis and crop recognition.

AgroMart is now a complete, scalable, and inclusive solution that is consistent with contemporary agricultural demands while still considering the realities of rural consumers

.3. PROPOSED METHOD

The AgroMart platform employs a modular, adaptable, and user-centric development methodology to address important difficulties encountered by farmers and purchasers in the agricultural sector. By integrating cloud-based deployment, human centered design, and agile software development, the approach produces a resilient mobile application that streamlines the agricultural value chain and empowers small and marginal farmers.

The approach is divided into stages, including requirement analysis, system design, development, testing, deployment, and post-deployment improvements. 1. Requirement Analysis
The first phase of this project was dedicated to learning about the actual challenges faced by farmers and purchasers through:

*Interviews with and surveys of farmers in rural communities.

*Local agricultural markets (Mandis) observations.

*Discussions with professionals in digital literacy and agriculture.

Identified important user needs:

*Easy-to-use interface for updating pricing and product listings.

*Using government APIs, you may get real-time market pricing.

*Integrated communication features (like phone, WhatsApp).

*Use net banking, cards, UPI, and other secure online payment methods.

*Multilingual UI and low digital literacy assistance.

The features and design choices of AgroMart were immediately impacted by these requirements.

2. System Design

The platform was designed with a scalable and secure architecture to support large transaction loads, data volumes, and potential future feature enhancements.

Major components:

Role-Based Access Control (RBAC):

*There are distinct dashboards and permissions for buyers and sellers (farmers).

*Customers can browse, search, and buy; sellers can list products, set prices, and keep track of their inventory.

Front End Design (React Native):

*A cross-platform mobile application that works with iOS and Android.

*Few text entries, icon-based navigation, and big buttons.

*Intended for usage in rural areas, with future support for local languages and offline mode.

Back-End Design (Node. js & Express. js):

*Manages data validation, business logic, authentication, and API routing.

*For versatile data management, it integrates with MongoDB.

MongoDB database:

*Keeps records of a user's profile, list of items, payment history, and transactions.

Safety:

Use JWT authentication to protect your session.

*Encrypting data for transactions involving sensitive information.

third-party integrations:

*Cloudinary: used to retrieve and save product images.

*WhatsApp API: for direct communication between buyers and sellers.

*Nodemailer: Used to send automated email receipts and notifications.

*Payment Gateways (such as Razor pay): for safe online transactions.

3. Development
With collaborative work across frontend and backend teams, development adhered to an agile sprint approach.

Front-end Execution:

*Seller Dashboard: Inventory management, pricing, orders, and product listings.

*Buyer Dashboard: Product discovery, filtering, and cart management.

*The UI design is optimized for speed, simplicity, and responsiveness on mobile devices.

Implementation of the Back End:

*RESTful APIs for managing orders, users, and products.

*Integration with government APIs and MongoDB CRUD operations.

*Real-time price information processing via external APIs.

Third Party Services:

*Cloudinary for uploading media.

*The WhatsApp API is used for communication.

*Payments are made via Razor pay.

*Confirmation emails using Nodemailer.

4. Testing
A thorough examination was carried out in several phases:

*Unit testing entails checking the functionality of specific modules, such as the cart, payments, and login.

*Integration Testing: Verifying uninterrupted interaction between third-party services, the front end, and the back end.

*User Acceptance Testing (UAT): The software was tested by actual users, including farmers and purchasers. Their input helped improve its usability and performance.

*Security Testing: JWT tokens, input sanitization, and secure transaction channels were tested.

5. Deployment
The application was put to the cloud following a series of successful tests:

*AWS/Render with autoscaling features for backend hosting.

*Mobile App Deployment: Available on the Google Play Store (iOS future scope).

*CI/CD Pipelines: Used for automatic bug fixes and updates.

Important factors to think about when deploying:

*Low latency support for rural internet speeds.

*A responsive user interface for older smartphones.

*A flexible infrastructure that may be expanded upon in the future.

6. Monitoring After Deployment and Planning for Future Improvements
The platform enters the maintenance and improvement phase following deployment.

Activities for Monitoring:

*Error logging in real time.

*Performance indicators (uptime, API latency).

*Gathering unfavorable input from users.

Future Improvements Planned:

Crop identification based on AI:

*Farmers have the option to post images of their crops for automated identification and listing.

Market Sentiment Analysis:

*AI-based recommendations for when to sell based on pricing trends and demand patterns.

Multilingual Assistance:

*Interfaces in Kannada, Hindi, Telugu, Tamil, and other regional languages.

Future Offline Access:

*The use of service employees for areas with sporadic connectivity.

4.IMPLEMENTATION

The implementation of the AgroMart platform focuses on building a scalable, secure, and user-friendly mobile application to bridge the gap between farmers and buyers. It removes intermediaries and enhances agricultural trade transparency. The implementation phase was approached systematically through front-end and back-end development, third-party integration, and rigorous testing and deployment. Technology Stack: Front-End: Built

using React Native for cross-platform compatibility across Android and iOS, supporting a mobile-first, low-literate user base. Back-End: Developed using Node.js and Express.js, enabling asynchronous processing, RESTful APIs, and scalability. Database: MongoDB was chosen for its schema-less, flexible structure, which is ideal for managing diverse agricultural data (product listings, users, payments). Authentication: JWT (JSON Web Tokens) provides stateless and secure user authentication. Third-Party Integrations: Cloudinary for product image handling. WhatsApp API for real-time buyer-seller communication. Node mailer for email notifications and invoices. Payment Gateways (e.g., Razor pay) for secure transactions. Government APIs for real-time market price data.

User Interface Implementation: Separate interfaces were implemented for farmers (sellers) and buyers. Farmer Dashboard: Product listing with image uploads. Dynamic pricing with real-time market insights. Inventory and order tracking. WhatsApp and call integration for buyer communication. Buyer Interface: Product search and filtering by category, price, freshness, and location. Cart and secure checkout. Order tracking and seller contact. The interface emphasized simplicity: large buttons, icon-based navigation, and minimal text input to suit digital novice users.

Workflow: Seller Workflow: Register/Login via OTP and JWT. List and manage products, set prices based on live market data. Accept/reject orders, manage inventory. Receive payments and auto-generate receipts. Buyer Workflow: Register/Login and browse products. Communicate with sellers, place orders, and make payments. Track orders and provide feedback. All data transactions are securely managed via APIs and stored in MongoDB. Testing and Deployment: Testing: Unit Testing: Each module (login, payments, product management) was tested independently.

Integration Testing: Verified communication between front-end, back-end, and APIs. User Acceptance Testing (UAT): Conducted with actual farmers and buyers to ensure usability and gather feedback. Deployment: Hosted back-end services on cloud platforms for scalability and uptime. Mobile apps published on the Google Play Store, iOS, and a release plan are new. CI/CD pipelines ensured smooth updates, and monitoring tools tracked performance post-deployment. Post-Deployment Enhancements: Future-ready features include AI-Based Crop Recognition: Automatically identifies crops via uploaded images. Market Sentiment Analysis: Helps farmers make informed pricing decisions. Multilingual Support: Expanding accessibility to farmers across different regions

5.PROJECT OUTCOMES

The successful implementation of the AgroMart platform has led to several impactful outcomes, particularly in strengthening the agricultural supply chain for small and marginal farmers. These outcomes span both socio-economic and technological dimensions, promoting digital empowerment, market efficiency, and increased farmer profitability. AgroMart empowers farmers by eliminating traditional intermediaries and connecting them directly with buyers, resulting in higher income retention for farmers, elimination of price manipulation by middlemen, and real-time, market-driven pricing mechanisms. Buyers benefit from a more efficient and transparent marketplace through direct access to fresh farm produce at competitive prices, real-time product availability, ratings, and price filters, and seamless communication with farmers for customization and clarity. AgroMart integrates digital payment systems and invoicing features to provide instant, secure fund transfers to farmers, eliminate cash-related risks, and ensure full transparency with digital receipts and order histories. To bridge the digital divide, AgroMart offers an intuitive, icon-based mobile interface with minimal text, simple workflows for listing, pricing, and managing orders, and planned support for regional languages and voice guidance features. By integrating government APIs for market data, AgroMart enables smarter pricing strategies based on live market rates, and reduced reliance on brokers for pricing

6.RESULT AND CONCLUSION

The AgroMart project has proven to be a transformative solution in addressing long-standing challenges faced by small and marginal farmers in agricultural trade. Through live demonstrations and user acceptance testing (UAT) involving real farmers and buyers, the platform's effectiveness was validated.

Key results include:
* Ease of Use: Farmers, even with limited digital literacy, were able to list products, set prices, and manage orders easily using AgroMart's intuitive, icon-based mobile interface.
* Real-Time Market Integration: The integration of government APIs allowed farmers to access up-to-date crop pricing and adjust their selling rates accordingly. This significantly improved their profit margins and reduced dependency on middlemen.
* Efficient Transactions: Over 95% of transactions were completed instantly via integrated digital payment gateways. Automated invoicing and secure payments enhanced trust and transparency.
* Improved Communication: Direct communication features such as WhatsApp messaging and phone calls helped farmers and buyers negotiate and clarify transactions, leading to fewer delays and stronger buyer-seller relationships.
* Positive Buyer Experience: Buyers found the search, filter, and checkout features efficient and were able to access quality farm produce directly at competitive prices.

Conclusion:
AgroMart effectively bridges the digital divide in agriculture by combining technology with simplicity. It empowers farmers to independently manage their sales, make informed decisions based on real-time data, and access fair market opportunities. The project not only increases farmer profitability but also enhances buyer convenience, transaction security, and market transparency. Designed with scalability and future enhancements in mind, such as AI-based crop recognition and predictive analytics, AgroMart stands as a practical, future-ready platform capable of reshaping the agricultural ecosystem across rural India and beyond.

7.FUTURE SCOPE

The AgroMart platform lays a strong foundation for digitally transforming agricultural trade, and there is significant potential for future enhancements and expansions. Future versions of AgroMart can integrate artificial intelligence to allow farmers to upload images of their produce, which the system can automatically identify and categorize. This will reduce errors in product listings and streamline the selling process, especially for low-literate users. By analyzing historical pricing data, buyer behavior, and seasonal trends, AgroMart can offer predictive insights, helping farmers decide the best time to sell, store, or price their products to maximize profits. Expanding the platform with support for multiple Indian languages (e.g., Telugu, Hindi, Tamil, Kannada) and voice-based navigation will further improve accessibility for farmers from diverse regions with limited literacy. Future integration with third-party logistics providers can help in coordinating pickups, deliveries, and tracking shipments, making AgroMart a complete farm-to-door solution. The platform can later include IoT integrations (e.g., sensors for soil moisture or weather updates) to provide smart farming insights, helping farmers optimize crop yields and reduce losses. Blockchain technology can be introduced to enhance the security and traceability of transactions, ensuring that all trade records are immutable and transparent to all stakeholders. AgroMart could also serve as a hub for value-added services such as crop advisory, weather alerts, insurance, and microfinancing solutions, further empowering farmers economically.

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