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Digital Platforms for Farmer Connectivity

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Abstract: ***The agricultural sector faces challenges in connecting small-scale farmers directly with consumers, often leading to inefficiencies, unfair pricing, and lack of transparency. "Farmers Connect" is a cross-platform mobile application designed to bridge this gap by enabling direct transactions between farmers and consumers. The application leverages Flutter for its user interface, while using Google Sheets and Google Apps Script for lightweight and real-time backend data management, eliminating the need for complex server infrastructures. Key features include a profile management system, product listings with pH-based food safety indicators, and the ability for farmers to manage and update product details directly. Customers can easily browse products, check quality indicators, and make informed purchase decisions. The system promotes food safety, enhances transparency, and empowers small-scale farmers by offering fair pricing and a direct market. Future enhancements planned for the platform include IoT-based pH sensors, AI recommendations, secure payment gateways, and blockchain integration, which would enhance scalability, efficiency, and trust within the ecosystem. This paper presents the design, implementation, and potential of "Farmers Connect" as a transformative solution for a more sustainable and equitable agricultural marketplace.***

I. INTRODUCTION

The agricultural sector, particularly for small-scale farmers, faces significant barriers to connecting directly with consumers. Traditionally, intermediaries such as wholesalers and retailers dominate the food supply chain, often leading to inflated prices and limited market access for farmers.

As a result, farmers struggle to receive fair compensation for their produce, while consumers face challenges in accessing fresh, high-quality food.

Farmers Connect is an innovative mobile application designed to address these challenges by facilitating a direct, transparent, and efficient marketplace between farmers and consumers. The application harnesses modern technologies, including Flutter for cross-platform mobile development, Google Sheets for lightweight backend data storage, and Google Apps Script as middleware, to enable seamless data management without the need for complex server infrastructure.

Farmers Connect aims to empower farmers by providing them with a user-friendly platform to list and manage their products, including essential food safety information, such as pH values that indicate product freshness and edibility. At the same time, the application offers consumers an intuitive interface to browse, evaluate, and purchase fresh produce directly from farmers. This eliminates the middleman, ensuring fair pricing and transparency throughout the transaction process.By focusing on food safety, product quality, and fair trade, Farmers Connect provides a unique solution to bridging the gap between consumers and farmers while contributing to a more sustainable and equitable agricultural ecosystem. This paper details the design, implementation, and future potential of the platform, highlighting its role in revolutionizing the agricultural marketplace.

II. LITERATURE REVIEW

The literature review examines various studies, frameworks, and technological implementations relevant to the creation and functioning of the Farmers Connect platform. It provides a deeper understanding of the challenges faced in the agricultural supply chain, the role of mobile applications in facilitating farmer-consumer direct interaction, and the integration of technological solutions like Flutter, Google Sheets, and IoT in enhancing food safety and marketplace transparency.

A. Agricultural Marketplace Challenges

The agricultural industry, particularly smallholder farmers, often faces inefficiencies and challenges in reaching consumers directly. Studies such as Swinnen & Vandeplas (2017) highlight the dominance of intermediaries and the difficulties in achieving fair pricing for farmers. The lack of transparency in food supply chains leads to skewed pricing, making it difficult for farmers to receive adequate compensation for their products.

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These intermediaries also reduce the connection between farmers and consumers, hindering the flow of important information regarding food quality and safety.

Moreover, Fafchamps (2004) discusses how farmers, especially in developing regions, lack direct access to modern distribution systems, limiting their ability to reach urban markets effectively. This underscores the need for direct marketplace solutions that empower farmers and improve accessibility for consumers.

B. Role of Mobile Applications in Agricultural Transformation

Mobile applications have become a crucial tool in modernizing agricultural practices and facilitating connections between farmers and consumers. By providing real-time information such as market prices, weather updates, and farming tips, mobile technology empowers farmers to make more informed decisions and reduces their reliance on middlemen. Mobile applications also enhance direct market access, enabling farmers to bypass traditional intermediaries and sell their products directly to consumers, as highlighted by various studies.

In the case of Farmers Connect, the mobile application plays a pivotal role by offering a direct communication channel between farmers and consumers. This mobile-first design ensures that even farmers in remote areas, where traditional technologies might be limited, can engage easily with the market using their mobile devices. By eliminating intermediaries, the platform empowers farmers to reach their customers more efficiently, fostering a transparent and fair trade system.

C. Backend Solutions: Google Sheets and Google Apps Script

The decision to utilize Google Sheets and Google Apps Script for the backend of Farmers Connect presents an innovative and resource-efficient alternative to traditional database systems. Cloud- based solutions like Google Sheets offer scalability, simplicity, and the ability to synchronize data in real- time, making them ideal for small-scale applications that need an easy-to-manage solution without complex server infrastructures. This approach aligns well with the requirements of Farmers Connect, where rapid development and low maintenance costs are key considerations.

Moreover, Google Apps Script is an ideal tool for automating backend processes and integrating data across platforms. It allows for efficient management of CRUD (Create, Read, Update, Delete) operations and ensures seamless data handling between the frontend (the mobile app) and the backend (Google Sheets), without the need for external APIs. This solution provides a lightweight method to manage data dynamically while minimizing the technical overhead and simplifying the overall architecture of the application

D. Go-Platform development with Flutter

Cross-platform development frameworks have grow to be important for building applications which might be able to walking on a couple of structures with out the want to increase separate codebases.

Flutter, an open-source framework advanced by means of Google, is an increasing number of diagnosed for its performance in mobile app improvement, thanks to its rapid development cycle, sturdy UI skills, and high performance. Flutter's capability to supply a steady user experience across numerous operating systems is specifically valuable for tasks that require speedy development, such as Farmers join. The framework's warm Reload characteristic permits builders to view actual-time changes, substantially accelerating the development method. moreover, Flutter offers a wealthy set of customizable UI widgets, which allows for the introduction of responsive and visually enticing apps. this is important for Farmers join, because it ensures a easy navigation experience for both farmers and clients, no matter the device being used.

E. Food Safety And Ph Cost Monitoring

making sure food protection is a critical concern in these days's market, particularly in relation to the quality and freshness of produce. Farmers join addresses this difficulty by using integrating pH cost tracking, which permits consumers to assess the protection and high-quality of the goods they're shopping. The inclusion of real-time pH value monitoring within the platform allows consumers to make higher-informed decisions about the freshness of perishable products like fruits, greens, and dairy items. pH values are a key indicator of product high- quality, as they replicate factors which includes acidity or alkalinity that affect freshness. through displaying these values on the product listings, Farmers connect fosters transparency and builds believe among farmers and consumers. this feature ensures that clients can confidently select products that meet their safety standards, contributing to a more informed and trustworthy market.

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III. METHODOLOGY

The Farmers Connect system was developed using an iterative and modular methodology, focusing on cross-platform accessibility, real-time data handling, and user-friendly interface design. The approach combined agile development practices with cloud- based data management tools to ensure efficiency, scalability, and rapid deployment.

A. System Development Lifecycle

The project followed the Agile Development Model, allowing for continuous testing, feedback, and refinement. Each feature was developed in short sprints, followed by usability testing and data validation. This ensured that both farmers and consumers could intuitively interact with the system at every stage of development.

B. Technology Stack

Frontend: Flutter and Dart were used to design a responsive and interactive user interface, compatible with both Android and iOS platforms.
Backend: Google Sheets served as the database for storing user profiles, product details, and order information.
Middleware: Google Apps Script was used as a serverless logic layer to handle data transactions (Create, Read, Update, Delete).
IDE: Visual Studio Code and Google ProjectIDX were used for development and testing.

C. Module-wise Implementation

1) User Onboarding and Profile Management

Instead of traditional login/signup systems, the app uses a lightweight onboarding approach. Users input their first name, last name, and a brief description ("about" section), which is stored in the Users sheet. Profiles can be updated from the profile screen, and changes are synced with Google Sheets in real-time.

2) Farmer Dashboard

Farmers can add new products by filling in a structured form containing fields like product name, category, price, and pH value. This information is stored in the Products sheet. They can also edit or delete listings, with changes reflected immediately.

3) Customer Dashboard

Consumers are presented with a dynamic list of available products. Details such as product name, price, category, and pH value are displayed. The pH value acts as a food safety indicator, allowing users to verify whether an item is suitable for consumption.

4) Order Management

When a customer places an order, the product ID, user ID, quantity, and timestamp are recorded in the Orders sheet. The order status is managed from the same sheet and can be updated as needed by the farmer or administrator.

5) pH-Based Food Safety Indicator

The system categorizes products based on pH values into “Good” (safe to consume) and “Bad” (not safe to consume). This data is input by farmers and displayed to consumers to ensure transparency and food quality.

D. Data Flow and Synchronization

All modules are connected through Google Apps Script, which acts as a middleware layer that automates communication between the Flutter frontend and Google Sheets backend. This ensures real-time synchronization of user and product data without requiring external APIs or traditional servers.

E. Testing and Validation

Unit testing was performed for each module to verify data flow integrity and UI responsiveness. Manual testing was also conducted with sample users (both farmers and consumers) to ensure the interface was intuitive and reliable. Functionalities such as product uploads, profile updates, and order placements were validated against predefined use cases.

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IV. EXISTING SYSTEM

In the current agricultural supply chain, traditional methods still dominate the interaction between farmers and consumers. These methods often involve multiple intermediaries such as wholesalers, distributors, and retailers, which results in increased product prices for consumers and reduced profits for farmers. Moreover, there is a significant lack of transparency regarding product origin, quality, and safety standards, particularly for perishable goods like fruits, vegetables, and dairy.

A. *Limitations of the Existing Agricultural Market System*

1) Dependence on Middlemen Farmers are typically dependent on intermediaries to reach markets. These intermediaries often exploit farmers by offering low purchase rates and adding their own margins, increasing the final cost for consumers.
2) Limited Market Reach Small-scale and rural farmers have restricted access to urban and digital markets. As a result, they are unable to directly reach a wider consumer base.
3) Lack of Food Safety Transparency Consumers have minimal visibility into the quality, freshness, or chemical content (e.g., pesticide residues) of agricultural products. There are no standard indicators, such as pH value, to determine product safety.
4) Manual and Delayed Transactions Transactions are mostly cash-based and recorded manually, leading to delays, potential fraud, and lack of traceability.
5) No Real-Time Inventory Updates Product availability is not updated dynamically, which can lead to overselling, wastage, or missed opportunities for both farmers and buyers.
6) Technology Gap Although mobile usage is growing in rural areas, most farmers lack access to tools that allow direct digital engagement with consumers. Existing solutions are often too complex or expensive for small-scale adoption.

B. Gaps Addressed by Farmers Connect

The Farmers Connect application is designed specifically to overcome these limitations by:

1) Eliminating middlemen through direct farmer-to-consumer transactions.
2) Leveraging mobile technology to reach rural users with a simple, intuitive interface.
3) Using Google Sheets and Google Apps Script for low-cost, real-time backend operations.
4) Introducing a pH-based food safety indicator to help consumers assess product quality.
5) Supporting real-time updates on product availability and order status.

V. PROPOSED SYSTEM

The proposed system, *Farmers Connect*, is a mobile- based solution aimed at transforming the traditional agricultural supply chain by directly linking farmers with consumers through a digital platform. This application eliminates the need for intermediaries, thereby ensuring fair pricing for farmers and providing consumers with direct access to fresh produce. Designed as a cross-platform application using Flutter, Farmers Connect delivers a seamless user experience across both Android and iOS devices while maintaining consistency in design and performance.

The system is built on a lightweight yet powerful three-tier architecture comprising a Flutter frontend, Google Sheets as the backend database, and Google Apps Script acting as the middleware. This combination was selected for its simplicity, scalability, and real-time data handling capabilities. By avoiding traditional server-side infrastructure and external APIs, the application ensures low development costs and minimal technical complexity, making it especially suitable for deployment in rural and small-scale agricultural communities.

Farmers Screen

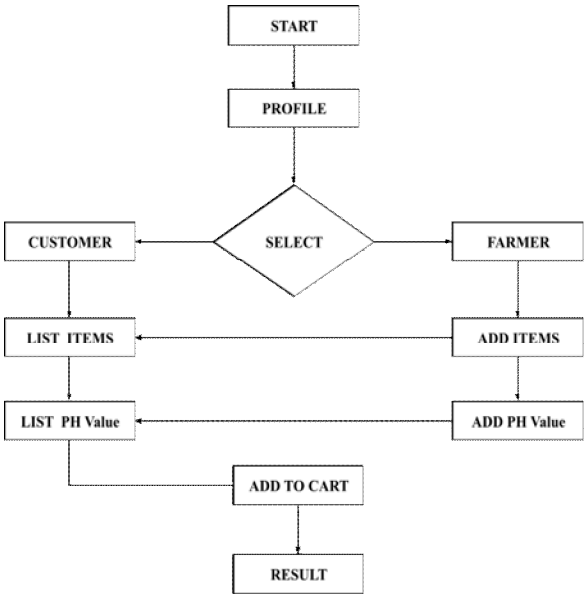
Upon launching the app, users are prompted to create a profile by entering their first name, last name, and a short description. These details are stored in a cloud-based Google Sheet for easy retrieval and management. Farmers are provided with an intuitive dashboard where they can list their products by submitting details such as the product name, category, price, and pH value. The pH value serves as an important parameter for determining the quality and edibility of food items, enabling consumers to assess whether the product is safe for consumption.

Consumers, on the other hand, access a separate dashboard that displays all available items in real- time. The user interface is designed to be visually appealing and interactive, allowing users to browse, compare, and purchase products effortlessly. When an order is placed, it is recorded in another dedicated Google Sheet along with customer and product identifiers, ensuring traceability and data integrity. The system also allows users to edit their profile details at any time through a profile management screen, which updates the backend immediately using Apps Script functions.

A unique feature of the proposed system is the integration of pH-based classification, which categorizes products as either "Good" (safe to consume) or "Bad" (not recommended for consumption) based on standard pH benchmarks. This feature fosters consumer trust by making food safety transparent and measurable. Real-time CRUD (Create, Read, Update, Delete) operations are seamlessly handled by Google Apps Script, which acts as the intermediary between the mobile app and the Google Sheets backend.

Overall, the Farmers Connect application offers a cost-effective, efficient, and user-friendly solution for bridging the communication and transaction gap between farmers and consumers. By combining modern mobile development tools with accessible cloud technology, the system promotes transparency, improves food safety awareness, and supports the economic growth of small-scale farmers in a digitally inclusive manner.

VI. DATA FLOW DIAGRAM



VII. ADVANTAGES OF THE PROPOSED SYSTEM

1) Direct Farmer-to-Consumer Trade – Eliminates middlemen to ensure fair pricing and direct transactions.
2) Cost-Effective Infrastructure – Uses Google Sheets and Apps Script to avoid server and database costs.
3) Real-Time Data Updates – Ensures instant synchronization of product and user data across the app.
4) Cross-Platform Compatibility – Built with Flutter to run seamlessly on both Android and iOS devices.
5) User-Friendly Interface – Provides an intuitive and visually appealing UI for easy navigation.
6) pH-Based Product Quality Check – Displays pH values to inform consumers about food safety.
7) Enhanced Transparency – Builds trust by offering clear insights into product freshness and quality.
8) Scalable and Future-Ready – Supports future integration of IoT, AI, and blockchain technologies.
9) Empowers Rural Farmers – Enables digital access for farmers with limited technical resources.
10) Improved Market Reach – Expands farmer visibility and customer access through mobile connectivity.

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VIII. RESULTS AND DISCUSSION

The implementation of the Farmers connect cell software has confirmed full- size fulfillment in bridging the space between farmers and clients. The device's architecture, based totally on Flutter, Google Sheets, and Google Apps Script, proved to be each sturdy and green for managing actual- time records with out requiring a conventional backend infrastructure. Upon checking out, the app functioned seamlessly across Android and iOS devices, imparting responsive performance and person-friendly navigation for each farmers and purchasers.

Farmers have been capable of check in, create profiles, and listing a couple of products easily, together with critical parameters together with pH price, class, and pricing. The pH-based totally classification of gadgets into "desirable" and "horrific" offered an progressive layer of food safety warranty, allowing consumers to make informed decisions. clients should effortlessl y browse listings, view product details, and vicinity orders without delay via the app, thereby validating the achievement of the direct-to- consumer model.

Person comments accumulated throughout prototyp e checking out highlighted the app's simplicity, speed, and usability, specially for rural users who had restricted revel in with virtual equipment. The actual- time update mechanism thru Google Sheets ensured correct and synchronized data across all modules, including person Profiles, merchandise, and Orders. furthermore, the light- weight middleware the use of Google Apps Script enabled reliable CRUD operations with out lag or facts loss.

In terms of performance, the machine maintained stability under concurrent consumer interactions, and facts retrieval times remained gold standard in spite of multiple product entries. The inclusion of functions including editableprofiles, established dashboards, and pH indicators notably stronger the overall person experience.

IX. CONCLUSION

Farmer join mobile application successfully addresses challenges confronted in conventional agricultu ral trade by using supplying a direct, transparent, green digital platform for farmers and clients. through leveraging Flutter for cross- platform development and using Google Sheets with Google Apps Script for backend operations,the software eliminates the want for com plex infrastructure whilst making sure actual- time records synchronization and consumer- pleasant interactions.

The integration of Ph value monitoring complements meals safety by using permitting customers to make well-informed buying choices based totally at the freshness and edibility of listed gadgets. The machine promotes fair pricing with the aid of casting off intermediaries and empowers small- scale farmers with a platform to exhibit and control their produce with ease.

Through intuitive modules along with farmer and consumer dashboards, profile control, and order monitoring, Farmers join provides a unbroken person revel in that is handy even to customers in far off regions. The a success implementation demonstrates how cellular generation can play a transformative position in modernizing agricultural markets, improving transparency,fostering consider between manufacturers and clie nts.

Typical, Farmers connect now not handiest supports sustainable agricultural practices however also contributes to constructing a more equitable farm-to- table environment, paving the way for destiny enhancements that incorpo rate AI, IoT, and blockchain for broader impact and scalability.

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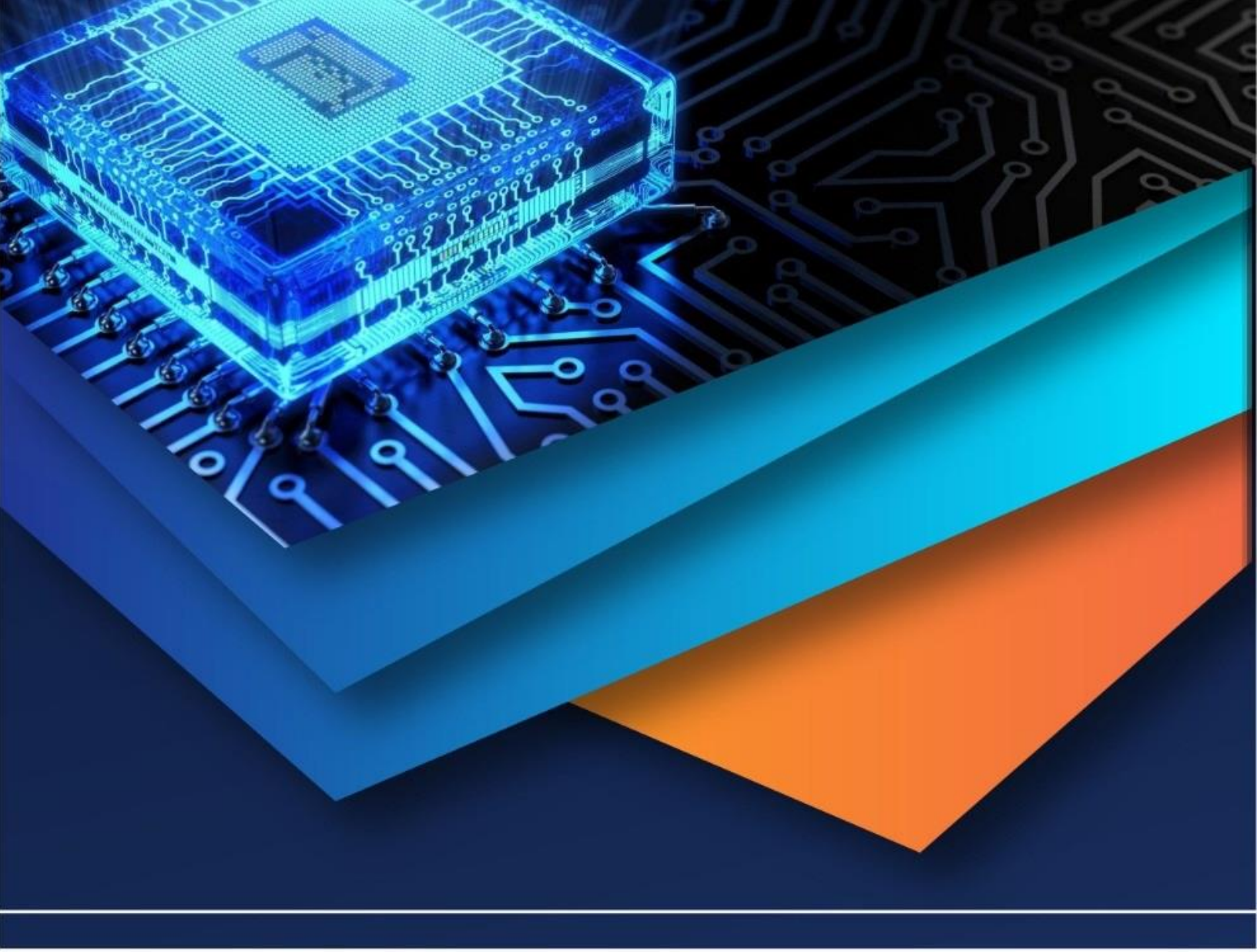

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