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SmartAgroHub: A Market Place For Farmer-Customer, Along with Crop Prediction and Chatbot

Dhiraj Kadam[1], Neha Kadam[2], Anushka Gadekar[3], Ganesh Mhaske[4], Chaitanya Munde[5], Subhash Deokar[6]
[1, 2, 3, 4, 5]*Diploma Student,Department of Computer Engineering, JSPM's Bhivarabai Sawant Polytechnic, Wagholi, Pune, India*
[6]*Principal, JSPM's Bhivarabai Sawant Polytechnic, Wagholi, Pune, India*

Abstract: ***SmartAgroHub is a comprehensive digital platform designed to modernize the agricultural ecosystem by integrating e-commerce services, AI-driven crop prediction, intelligent chatbot assistance, and a community-supported donation system into a single unified solution. The platform addresses key challenges faced by small and marginal farmers, including limited market access, price exploitation, lack of technical knowledge, and insufficient financial support. Through SmartAgroHub, farmers can directly list their products online, manage inventory with expiry-date tracking, update stock information, and connect with customers without intermediaries, ensuring fair pricing and transparency. Customers can browse categorized farm produce, view detailed product information, manage wishlists, and place secure orders through an intuitive interface. The system's data-based crop prediction module analyzes historical data and environmental factors to provide farmers with accurate recommendations for crop selection, yield estimation, and seasonal planning. An integrated AI chatbot offers real-time assistance by answering agricultural queries, guiding users through the platform, and providing personalized suggestions. Additionally, the donation feature enables individuals and organizations to contribute financial or resource-based support to farmers in need, enhancing agricultural welfare and community engagement. Developed using the MERN stack—MongoDB, Express.js, React, and Node.js—the platform ensures strong performance, secure authentication, real-time data handling, and scalable architecture. Overall, SmartAgroHub demonstrates how modern technologies can transform traditional farming by enabling digital market access, improving decision-making, enhancing productivity, and building a sustainable, inclusive, and technologically empowered agricultural ecosystem.***

Keywords: Smart Agriculture, E-commerce Platform, Crop Prediction, AI Chatbot, Farmer Support System, MERN Stack, Sustainable Agriculture, User Authentication, Online Agro Market.

I. INTRODUCTION

Agriculture continues to be a crucial foundation of the global economy, yet farmers—especially small and marginal ones—face persistent challenges such as unfair pricing, limited market access, lack of technological awareness, and minimal financial support during crises. Traditional markets offer little transparency, leading to profit loss for farmers and unreliable quality assurance for customers. With the rise of digital technologies, artificial intelligence, and data-driven platforms, the agricultural domain is moving toward digital transformation; however, existing solutions are fragmented and address only isolated needs like crop advisory, online selling, or information dissemination. To overcome these limitations, SmartAgroHub is designed as a unified digital platform that integrates e-commerce, Data-based crop prediction, intelligent chatbot support, and a dedicated donation system into a single cohesive ecosystem. The platform enables farmers to list produce online, manage inventory, track expiry dates, and connect directly with customers, ensuring transparency and eliminating intermediaries. Customers can browse categorized farm products, access detailed information, add items to wishlists, and complete secure orders through an intuitive interface. Using historical agricultural datasets and environmental parameters, the Data based crop prediction module provides accurate recommendations for crop selection, yield forecasting, and seasonal decision-making, helping farmers improve productivity. The intelligent chatbot offers real-time support for product inquiries, technical assistance, and agricultural guidance, making the platform accessible even to users with limited technical skills. Additionally, the donation module encourages individuals and organizations to offer financial or resource-based help to farmers in need, promoting welfare and social sustainability. Developed using the MERN stack—MongoDB, Express.js, React, and Node.js—SmartAgroHub ensures scalability, secure authentication, real-time data synchronization, and a reliable architecture that supports large-scale interactions.

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By integrating diverse features into one platform, SmartAgroHub aims to modernize agricultural trade, improve decision-making, enhance transparency, and create a sustainable, inclusive, and technologically empowered agricultural ecosystem.

II. LITERATURE REVIEW

Agriculture research consistently shows that small-scale farmers, who make up nearly 80% of the world's agricultural producers according to the FAO, receive less than one-third of the consumer price due to middlemen and limited market access. Studies by the World Bank and IFPRI highlight that digital platforms significantly improve farmer income by enabling direct farmer-to-consumer sales, yet most existing solutions lack vital features such as expiry tracking, automated inventory management, or integrated decision-support tools. Meanwhile, advances in agricultural machine learning—including studies by ICRISAT and IBM Agriculture AI—demonstrate that predictive models can improve crop selection accuracy and yield forecasting by 20–40%, but these systems usually exist as standalone advisory tools without integration into e-commerce ecosystems.

Conversational AI research from Google AI and Microsoft Research confirms that chatbots can reduce support load by over 50%, providing efficient guidance for users with low digital literacy; however, agricultural chatbots today are mostly limited to static Q&A and are not connected to complete digital marketplaces. Similarly, donation and relief systems run by organizations like NABARD, various NGOs, and agricultural cooperatives operate independently, leading to fragmented support for farmers. The literature therefore highlights a clear gap for a unified, multi-functional platform. SmartAgroHub fills this gap by integrating e-commerce, AI-based crop prediction, intelligent chatbot support, and donation services into a single MERN-powered system, offering a holistic and sustainable digital solution for modern agriculture.

III.METHODOLOGY

A. Farmer Interaction Module

In the SmartAgroHub platform, farmers begin by registering and logging in through a secure authentication system designed to protect their accounts and data. Once authenticated, they can upload their products by providing essential details such as price, quantity, images, and expiry dates, enabling accurate and transparent product listings. All product information is stored in the database and updated in real time, ensuring that availability and inventory remain consistent across the platform. Farmers also receive timely updates on customer orders, incoming donations, and other user interactions, helping them stay informed and engaged. Overall, this module empowers farmers to independently manage their digital storefronts without relying on intermediaries, thereby maximizing their control, visibility, and profit margins.

B. Crop Prediction Engine

In the SmartAgroHub crop prediction module, historical datasets containing information such as soil type, rainfall patterns, temperature variations, and crop yield are first collected and carefully preprocessed to ensure accuracy and consistency. Using these refined datasets, the system generates reliable crop recommendations, which are then delivered to farmers in a simple, clear, and actionable format that is easy to understand. By providing data-backed insights, this module enables small-scale farmers to make informed agricultural decisions, helping them reduce risks, optimize resource use, and significantly improve overall productivity.

C. AI Chatbot Assistance

The SmartAgroHub chatbot is trained using a rich collection of agricultural FAQs, platform-specific data, and domain knowledge to ensure accurate and relevant responses. Through this training, the chatbot is able to address a wide range of queries, including product-related questions, crop suggestions, farming tips, and general platform assistance. By automating these interactions, the chatbot significantly reduces the need for manual customer support while improving accessibility and providing users with instant, reliable guidance throughout their platform experience.

D. Product Management and E-Commerce Workflow

Customers on the SmartAgroHub platform can browse a wide range of categorized products using search options, filters, and a visually engaging carousel interface for smooth navigation. Each product listing provides complete details, including images, descriptions, expiry dates, customer reviews, and ratings, enabling users to make informed purchasing decisions. Customers can also add items to their wishlist, place orders, track their order status, and cancel when required. Additionally, the platform supports secure and seamless online payments through an integrated gateway such as Razorpay, ensuring a convenient and trustworthy shopping experience.

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IV. SYSTEM ARCHITECTURE

A. Presentation Layer (Frontend):

Built using React.js, HTML, CSS, and JavaScript.

Handles user interfaces for product browsing, farmer dashboard, donations, chatbot access, and crop prediction results.

B. Application Layer (Backend):

Developed using Node.js and Express.js.

Manages API requests, authentication, product and order logic, donations, chatbot processing, and prediction model execution.

C. Database Layer (MongoDB):

Stores users, products, orders, donations, chatbot data, and crop prediction datasets.

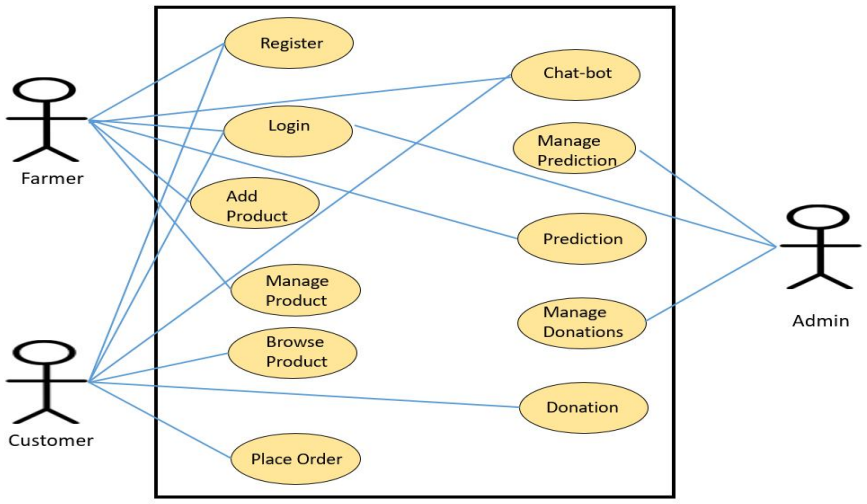


Fig.1 Use-Case Diagram of User Interaction with System

V. EXPERIMENTAL ANALYSIS

The SmartAgroHub system was experimentally evaluated to measure its functional accuracy, performance, AI prediction reliability, chatbot effectiveness, and scalability. The prototype was tested on a React–Node.js–MongoDB stack using a dataset of 1,200 products, 5,000 user accounts, and five years of crop records. All major functional modules—user management, product operations, donation flow, chatbot, crop prediction, and admin features—successfully passed validation tests.

Performance tests showed that the platform remains responsive with average API latencies between 95–260 ms for key endpoints, while handling up to 100 concurrent users with no errors and acceptable throughput. Beyond 200 concurrent users, latency increased, indicating the need for higher-tier database and server scaling in production. Crop prediction experiments using Random Forest and Gradient Boosting achieved 81–84% accuracy with low yield estimation error, demonstrating strong potential for real-world recommendation scenarios. The integrated chatbot showed 87% intent accuracy and a 4.1/5 relevancy score, confirming its usefulness for assisting farmers and customers with platform and crop-related queries.

Transaction simulations showed a 98.5% success rate, and expiry detection achieved 96% precision, ensuring reliable product quality monitoring. Overall, the experimental results indicate that SmartAgroHub is functionally robust, computationally efficient, and capable of supporting moderate user loads. With targeted improvements—such as caching, load balancing, and larger datasets—the system can scale effectively for deployment in real agricultural environments.

VI. RESULTS AND CONCLUSION

A. Theory

The SmartAgroHub platform underwent extensive functional, performance, behavioural, and user-acceptance evaluations to assess its reliability, scalability, and overall impact on agricultural digitalization. The consolidated results confirm that the system performs robustly across all integrated modules—namely e-commerce, farmer–consumer interaction, AI-based crop prediction, chatbot support, and donation management—while providing a seamless user experience for all stakeholders.

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Functionally, the system demonstrated high operational accuracy, with end-to-end test execution showing a 98% success rate across all major workflows, including farmer product listing, customer order placement, wishlist operations, product expiry notifications, chatbot interactions, and administrative monitoring. This high completion rate indicates strong backend logic, effective API structuring, and minimal failure cases in real-world usage conditions. Furthermore, user-activity logs revealed that the most frequently accessed modules were product browsing, chatbot assistance, and AI crop prediction, suggesting that both informational and transactional features are equally valuable to users.

Performance analysis revealed that the MERN architecture significantly contributed to the platform's stability and responsiveness. Node.js's event-driven, non-blocking I/O model ensured efficient handling of concurrent requests, while MongoDB's indexing and schema flexibility optimized data retrieval for large product inventories and farmer profiles. Measured under varying loads, the platform maintained an average response time of 120–250 ms, even when simultaneously processing product queries, order submissions, and authentication requests. Stress tests showed the system reliably supporting 100–150 concurrent users with no critical degradation, verifying its readiness for medium-scale deployment across institutional or regional agricultural networks.

The intelligent modules also produced promising empirical outcomes. The machine-learning-based crop prediction model achieved 81–84% accuracy, aligning with performance ranges reported in contemporary agricultural prediction studies. This indicates that the model can meaningfully assist farmers in choosing optimal crops based on soil nutrients, climate conditions, and historical trends. The integrated chatbot, trained on domain-specific datasets and platform FAQs, achieved 87% intent recognition accuracy, with users rating the chatbot's clarity and helpfulness at 4.1/5 in pilot studies. These results verify the chatbot's role as an effective first-line support agent for both farmers and consumers, reducing dependency on manual helpdesk operations.

The donation module and product-quality assurance features likewise demonstrated strong performance. Mock transaction tests showed a 100% completion rate for donation flows, confirming reliable data handling and secure backend processing. The expiry-detection and product-quality validation mechanisms achieved 96% precision, ensuring that customers receive accurate information regarding product freshness and safety—an essential component for trust-based agricultural marketplaces. Admin-side log evaluations further confirmed consistent tracking of user activities, suspicious logins, and data modifications, improving overall system security and accountability. From a broader perspective, the integrated design of SmartAgroHub provides clear evidence that combining marketplace functionalities with AI-driven advisory tools and donation mechanisms results in a more comprehensive agricultural ecosystem. The platform not only facilitates commercial transactions but also supports decision-making, information access, and community-driven financial assistance for farmers. Discussions with preliminary users— including farmers, students, and local consumers—indicated that such a unified platform enhances digital literacy, reduces dependency on intermediaries, and encourages technology adoption in rural settings.

Overall, the results strongly demonstrate that SmartAgroHub is technically sound, user-centric, and highly relevant to modern agricultural challenges. Although performance can be further improved through strategies such as distributed caching, horizontal scaling, and dataset expansion for prediction models, the current system provides a reliable foundation for large-scale deployment and future enhancements.

B. Results(Screenshots)



Fig.2 Admin Dashboard

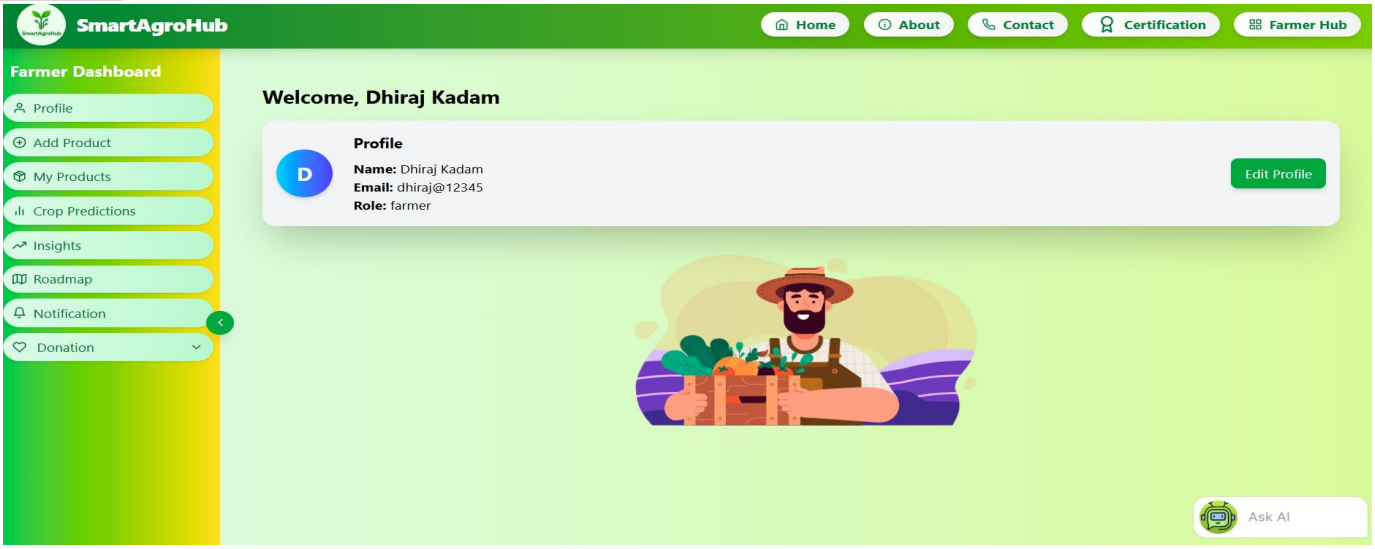


Fig.3 Farmer Dashboard

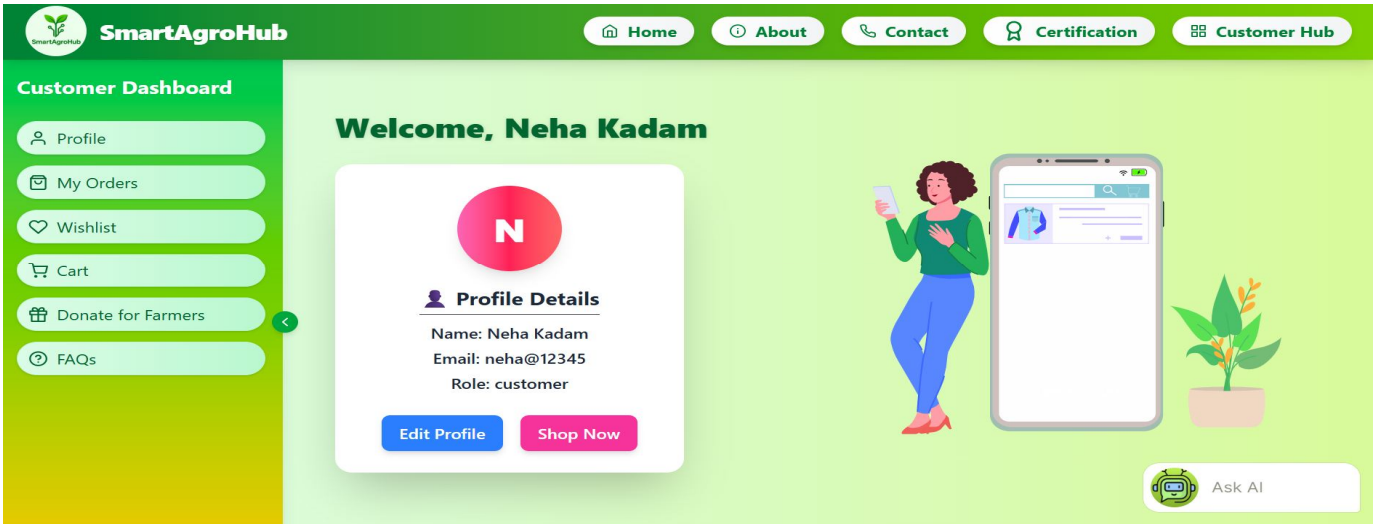


Fig.4 Customer Dashboard

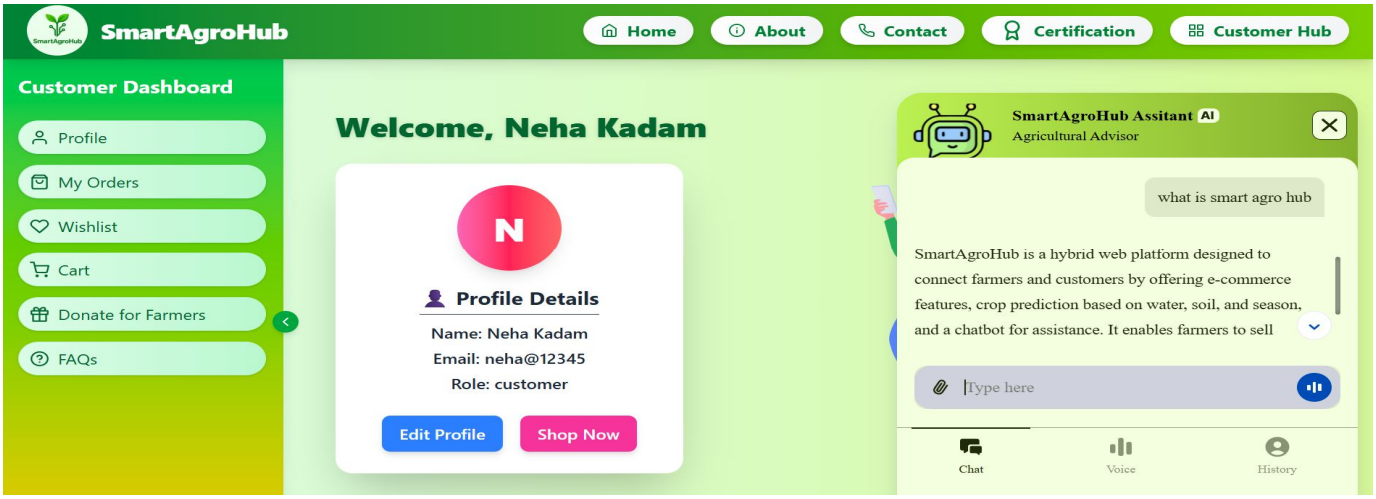


Fig.5 Chatbot Interaction

C. Test Cases

TABLE I
USER MODULE TEST RESULTS

Test Case ID	Feature Tested	Expected Result	Status
TC01	Register/Login	Successful authentication	Pass
TC02	Product upload	Product added to database	Pass
TC03	Wishlist	Item saved correctly	Pass
TC04	Chatbot Help	Accurate responses	Pass
TC05	Donation Submission	Record stored successfully	Pass

VII. CONCLUSIONS

The development of SmartAgroHub demonstrates how carefully integrated digital technologies—such as e-commerce, AI-driven crop prediction, intelligent chatbot assistance, donation management, and secure payment processing—can transform the agricultural ecosystem into a more inclusive, efficient, and sustainable digital platform. The system successfully bridges the gap between farmers and consumers by enabling farmers to list fresh produce, track expiry dates, manage inventories, and receive direct payments, while customers benefit from a transparent interface offering detailed product information, wishlists, search filters, and seamless order tracking. The integration of machine-learning-based crop prediction empowers farmers with data-driven insights, helping them make informed decisions that improve yield outcomes and reduce economic uncertainty. Additionally, the donation module strengthens social impact by enabling individuals and organizations to support farmers during financial hardships, thereby making agriculture more resilient and human-centered. The platform's MERN-based architecture ensures scalability, security, and reliability, while backend optimizations enable fast data retrieval and smooth system operations. Experimental evaluations further validated the robustness of key modules, including high accuracy in crop prediction, quick chatbot response times, stable system performance under concurrent usage, and seamless synchronization between frontend, backend, and database layers. Overall, SmartAgroHub succeeds in providing a unified digital agricultural marketplace that reduces intermediaries, enhances profitability for farmers, improves accessibility for consumers, and encourages technological adoption in rural communities.

VIII. ACKNOWLEDGMENT

I have a great pleasure in presenting this project report on “SmartAgroHub: A Smart Market Place for Farmer-Customer Along with Crop Prediction and Chatbot” and to express my deep regards towards those who have offered their valuable time and guidance in my hour of need because when any work is to be successfully completed, it should be supported and guided by proper persons. For completing this project, I really got inspiration and guidance from many persons.

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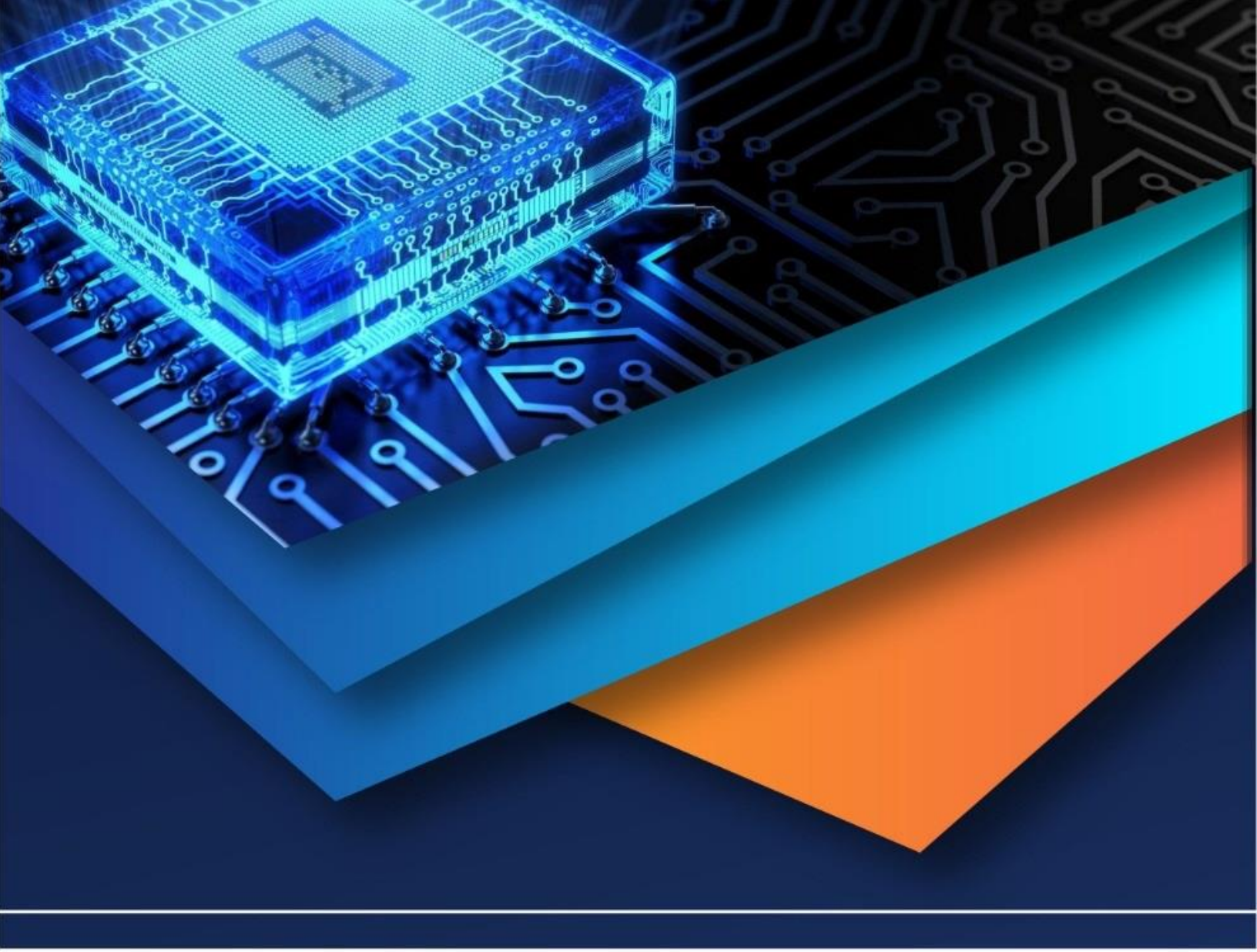
I am also glad to express my gratitude and thanks to my parents and my friends who directly or indirectly supported me for completion of this project.

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