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**APPLICATION OF MACHINE LEARNING IN AGRICULTURE DISSERTATION**

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**By**

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**Under the supervision of**

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# **DEDICATION**

This initiative celebrates the relentless pursuit of knowledge and insight in the modern digital world. It is dedicated to those who venture into the vast realm of social media, aiming to bring clarity to its complexity. Driven by the work of researchers, data analysts, and technology innovators who craft novel tools and approaches, this project seeks to acknowledge their commitment to enhancing our understanding and organization of the vast information found in tweets, thereby making it more accessible and comprehensible to everyone.

Furthermore, this effort honors the wide-ranging international community of Twitter users, whose diverse voices and viewpoints contribute to our shared discourse. It recognizes their crucial impact on molding public perspectives, elevating awareness, and promoting digital solidarity across geographical divides.

For the educators and students who will interact with this project, it is hoped to spark curiosity and fuel their quest for knowledge. And to our families and friends, whose constant encouragement supports all our endeavors, this project is a symbol of the power of community.

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# **ABSTRACT**

Online shopping applications have undergone significant evolution, incorporating a multitude of features to optimize user experience and facilitate seamless transactions. Central to this evolution is the prioritization of intuitive User Interface (UI) and User Experience (UX) design, emphasizing easy navigation, clear product descriptions, and a streamlined checkout process. Robust Product Listing and Management ensure comprehensive product details, images, and efficient search filters for quick item discovery. Key functionalities such as Shopping Cart and Delivery mechanisms focus on secure transactions and offer diverse payment options. User Accounts and Profiles enable customers to save preferences and track order history securely. Effective Order Management and Tracking provide real-time updates on order status, ensuring smooth order fulfillment and delivery. Promotions and discounts, including coupons and loyalty programs, attract and retain customers. Review and Ratings systems promote transparency and aid purchasing decisions by allowing customers to provide feedback. Responsive Customer Support through various channels ensures prompt query resolution. Emphasis on Security and Privacy ensures safeguarding of sensitive user data and compliance with regulations. Overall, these features collectively enhance the online shopping experience, fostering customer satisfaction and loyalty.

# **Chapter – 1**

# **Introduction**

* 1. **Background and context of the study**

The growth and popularity of online shopping has transformed the retail landscape, providing consumers with unprecedented convenience and access to a wide range of products. The history of online shopping can be traced back to the growth of e-commerce and the advancement of internet connectivity. Here is a brief background of online shopping apps:

1. The emergence of e-commerce: The concept of online shopping emerged from e-commerce in the late 20th century. Early websites allowed users to browse and purchase products online, eliminating the need for a physical store.

2. Advances in technology: The emergence of secure online payments and advances in Internet security technology have led to the development of e-commerce. Security protocols such as SSL (Secure Sockets Layer) are becoming standard, increasing trust in online commerce.

3. Mobile Revolution: The widespread use of smartphones in the early part of the century played a significant role in online production. Mobile devices provide a shopping experience over the phone to users who do not have internet access.

4. The rise of mobile apps: With the increasing use of mobile devices, companies are realizing the need to optimize their online stores for mobile devices. This has led to the development of mobile applications that offer a more user-friendly experience compared to mobile websites.

5. Customer centricity: Online shopping applications prioritize user experience, use simple communication, seamless navigation and personalized customer satisfaction and engagement recommendations.

6. Business models: The emergence of online commerce allows many sellers to offer their products on a single platform, further expanding the range of products available to customers. Popular examples include Amazon, eBay and Flipkart.

7. Integration of mobile payments: Integration of mobile payment systems such as digital wallets and payment gateways streamlines the payment process and ensures more efficient business speed and security.

8. Global trade and cross-border shopping: Online shopping has facilitated cross-border trade and allowed consumers to access products from all over the world. This international business expands the business scope of enterprises and increases the product choices of consumers.

9. Marketing integration: Online marketing applications integrate social media content so users can discuss and share their purchases, recommendations, and comments. This economic activity has accelerated the growth of online stores.

10. Constant Innovation: Online shopping app continues to evolve through constant innovation. Features such as augmented reality for virtual product trials, artificial intelligence for personalized recommendations, and voice shopping are examples of recent developments.

11. Issues and Security: As online shopping grows, issues related to online security, privacy and fraud also arise. Online stores regularly invest in security measures to protect user data and build trust. The background of online shopping apps reflects a dynamic journey driven by technological advancements, changing consumer behaviour, and a commitment to enhancing the overall shopping experience.

**Statement of the problem**

Despite the evolution of online shopping applications and the incorporation of numerous features to optimize user experience, there remain persistent challenges that hinder seamless transactions and detract from user satisfaction. One major issue is the lack of uniformity and consistency in User Interface (UI) and User Experience (UX) design across various platforms, leading to confusion and frustration among users. This inconsistency often results in difficulties in navigation, unclear product descriptions, and a cumbersome checkout process, ultimately impeding the efficiency of online shopping.

Additionally, while many applications boast robust Product Listing and Management systems, there are still instances where product details are incomplete, images are unclear, and search filters are ineffective, making it challenging for users to quickly find desired items. Moreover, the Shopping Cart and Delivery mechanisms, while present, may not always prioritize secure transactions and diverse payment options, leading to concerns about the safety of personal and financial information.

Furthermore, despite the provision of User Accounts and Profiles, there are instances where the saving of preferences and tracking of order history are not seamless or secure, potentially compromising user data. Inadequate Order Management and Tracking systems further exacerbate the problem by failing to provide real-time updates on order status, resulting in uncertainty and dissatisfaction among users.

Moreover, while promotions, discounts, and loyalty programs are implemented to attract and retain customers, the execution of these strategies may lack effectiveness or fail to target the right audience, thereby diminishing their impact. Similarly, Review and Ratings systems may not always foster transparency or aid purchasing decisions due to fake reviews or insufficient feedback.

Lastly, while efforts are made to provide responsive Customer Support and prioritize Security and Privacy, inconsistencies and gaps in these areas can undermine user trust and confidence in the platform.

In summary, the challenges within online shopping applications revolve around inconsistencies in UI/UX design, incomplete product management, security concerns, and ineffective customer support mechanisms. Addressing these challenges is imperative to enhance user satisfaction, foster loyalty, and ensure the long-term success of online shopping platforms.

Enter the realm of precision agriculture, where the integration of machine learning (ML) technologies offers a promising solution to these challenges. ML algorithms can analyze vast datasets, identifying patterns and insights that humans cannot easily discern. However, the application of such technologies in agriculture is not without its challenges. The variability of weather patterns, the diversity of crops, and the complexity of soil ecosystems present significant obstacles to developing accurate predictive models. Furthermore, the accessibility of these technologies for farmers, particularly in developing countries, and the need for substantial datasets for model training are critical issues that need addressing.

This project aims to bridge the gap between advanced ML technologies and practical agricultural applications. By focusing on crop recommendation and rainfall prediction, it endeavors to provide farmers with actionable insights that can lead to optimized crop yields, efficient resource use, and enhanced resilience to climatic changes. This research not only contributes to the academic body of knowledge on precision agriculture but also offers a scalable solution that could revolutionize farming practices worldwide, paving the way for a more sustainable and food-secure future.

## **Objectives and significance of the research**

The objectives of this research are multifaceted, aiming to comprehensively explore the evolution of online shopping applications and the integration of various features geared towards enhancing user experience and facilitating seamless transactions. The significance lies in understanding how these advancements in user interface (UI) and user experience (UX) design have influenced consumer behavior, shaped industry standards, and contributed to the success of e-commerce platforms.

Firstly, the research seeks to analyze the specific features incorporated into online shopping applications and their impact on user satisfaction and engagement. By dissecting elements such as intuitive UI, robust product listing, and streamlined checkout processes, the study aims to identify the most influential factors driving positive user experiences.

Furthermore, the research aims to investigate the effectiveness of key functionalities like shopping cart management, delivery mechanisms, and order tracking systems in fostering trust and confidence among users. Understanding how these features contribute to the overall reliability and convenience of online shopping platforms is crucial for both businesses and consumers.

Moreover, the research will delve into the role of promotions, discounts, and loyalty programs in customer acquisition and retention. By examining the effectiveness of these marketing strategies in attracting and retaining customers, the study aims to provide insights into optimizing promotional efforts for online retailers.

Additionally, the research will explore the importance of responsive customer support and stringent security measures in ensuring user trust and loyalty. Understanding how these aspects contribute to customer satisfaction and mitigate risks associated with online transactions is vital for the long-term success of e-commerce platforms.

Overall, this research aims to provide valuable insights into the evolution of online shopping applications and their impact on consumer behavior and industry dynamics. By addressing these objectives, the study aims to contribute to the advancement of e-commerce practices and facilitate informed decision-making for businesses operating in the digital marketplace.

**Overview of the methodology**

The methodology for developing and implementing the aforementioned features in online shopping applications involves a comprehensive approach that integrates various stages from initial planning to execution and ongoing optimization.

1. User Research: Understanding user needs, preferences, and pain points through surveys, interviews, and data analysis is crucial. This informs decisions regarding feature prioritization and design.

2. UX/UI Design: Utilizing principles of user-centered design, wireframing, and prototyping to create intuitive interfaces and seamless user experiences. Iterative testing and refinement ensure alignment with user expectations.

3. Product Management: Collaborating with stakeholders to define product requirements and features. Implementing robust systems for product listing, categorization, and management, ensuring comprehensive and accurate product information.

4. Development and Integration: Employing agile development methodologies to iteratively build and integrate features. Implementing secure shopping cart and payment gateways, as well as user account systems with robust security measures.

5. Quality Assurance: Conducting thorough testing across various devices and browsers to ensure functionality, usability, and security. Addressing any issues identified through user feedback and testing.

6. Marketing and Promotion: Strategizing promotional campaigns, discounts, and loyalty programs to attract and retain customers. Monitoring effectiveness through analytics and adjusting strategies accordingly.

7. Customer Support: Establishing responsive support channels, including live chat, email, and phone support, to address customer inquiries and concerns promptly. Implementing ticketing systems for efficient query resolution and tracking.

8. Security and Compliance: Integrating security protocols and encryption techniques to safeguard user data and ensure compliance with privacy regulations such as GDPR or CCPA.

9. Continuous Improvement: Monitoring user feedback, analytics, and market trends to identify areas for improvement. Iteratively enhancing features and optimizing the application to meet evolving user needs and preferences.

**Peculiarity of This Project**

The evolution of online shopping applications has been marked by a distinctive focus on enhancing user experience through a myriad of innovative features. One notable peculiarity lies in the meticulous attention given to the fusion of intuitive User Interface (UI) and User Experience (UX) design elements. This emphasis underscores the commitment to seamless navigation, transparent product descriptions, and a frictionless checkout process, ultimately prioritizing user convenience.

A hallmark feature is the implementation of robust Product Listing and Management systems, ensuring comprehensive product details and efficient search filters for swift item discovery. This not only enhances user satisfaction but also accelerates the purchasing process. Moreover, the integration of secure Shopping Cart and Delivery mechanisms, coupled with diverse payment options, fortifies trust in transactions and expands accessibility for customers.

Another distinctive aspect is the emphasis on User Accounts and Profiles, allowing customers to securely save preferences and track order history. This personalized touch enhances user engagement and fosters long-term relationships. Furthermore, the emphasis on effective Order Management and Tracking, providing real-time updates on order status, exemplifies a commitment to ensuring smooth order fulfillment and delivery.

Promotions and discounts, including coupons and loyalty programs, serve as powerful tools to attract and retain customers, showcasing a strategic approach to customer acquisition and retention. Additionally, the incorporation of Review and Ratings systems empowers customers by providing transparent feedback mechanisms, aiding purchasing decisions and fostering a sense of community.

Responsive Customer Support channels further differentiate these applications by ensuring prompt query resolution, thereby enhancing overall user satisfaction and trust. Lastly, a strong emphasis on Security and Privacy highlights a dedication to safeguarding sensitive user data and ensuring compliance with regulatory standards, ultimately underpinning the foundation of trust upon which these applications thrive. Together, these peculiarities exemplify a holistic approach to optimizing the online shopping experience, driving customer satisfaction and loyalty.

# **Chapter – 2**

# **Literature Review**

**2002 - Gefen, D. - "The Role of Trust in Online Shopping"**

In Gefen's seminal work, "The Role of Trust in Online Shopping," the outcomes shed light on the crucial significance of trust in the realm of e-commerce. Through empirical investigation and theoretical analysis, Gefen demonstrates that trust plays a pivotal role in shaping consumers' attitudes and behaviors towards online shopping platforms. The study reveals that trust serves as a fundamental determinant of consumers' willingness to engage in online transactions, influencing their perceptions of risk, credibility, and reliability associated with e-commerce vendors.

One of the key outcomes of Gefen's research is the identification of trust-building mechanisms employed by online retailers. These mechanisms include factors such as website security features, privacy policies, customer reviews, and reputation management strategies. By establishing and maintaining trustworthiness, online merchants can mitigate consumers' concerns and foster confidence in their products and services, thereby facilitating repeat purchases and loyalty.

Furthermore, Gefen's findings highlight the nuanced nature of trust formation in the online shopping context. The study emphasizes that trust is not solely based on objective indicators of reliability but is also influenced by subjective perceptions and experiences. Factors such as website design, user interface, and customer service interactions play crucial roles in shaping consumers' trust perceptions and overall shopping experiences.

Overall, Gefen's research underscores the importance of trust as a foundational element of successful online commerce. By understanding the mechanisms through which trust is established and maintained, businesses can implement strategies to cultivate consumer confidence, enhance brand reputation, and ultimately drive sustainable growth in the competitive landscape of e-commerce.

**2020 - Sugandini et al. - "INTENTION TO USE: STUDY ONLINE SHOPPING BASED ON ANDROID APPLICATIONS"**

In Sugandini et al.'s study on "Intention to Use: Study Online Shopping Based on Android Applications," the research investigates the determinants influencing consumers' intentions to use online shopping applications, specifically focusing on the Android platform. Through empirical analysis, the study reveals several key outcomes:

1. Perceived Usefulness: The research finds that consumers' perceptions of the usefulness of online shopping applications significantly impact their intention to use them. Factors such as convenience, time-saving benefits, and access to a wide range of products contribute to users' perceptions of utility.

2. Perceived Ease of Use: The study identifies perceived ease of use as another crucial determinant affecting consumers' intention to use online shopping apps. User-friendly interfaces, intuitive navigation, and seamless transaction processes enhance users' perceived ease of using the applications, thereby positively influencing their adoption intentions.

3. Trust: The research highlights the importance of trust in fostering consumers' intentions to use online shopping applications. Factors such as the security of payment systems, privacy protection measures, and the reliability of product delivery services significantly influence users' trust in the platform, ultimately shaping their willingness to engage in online shopping activities.

4. Social Influence: The study reveals that social factors, including recommendations from friends, family, or online reviews, exert a considerable influence on consumers' intentions to use online shopping apps. Positive word-of-mouth and social validation enhance users' confidence and trust in the platform, motivating them to adopt and use the applications.

5. Perceived Risk: The research acknowledges the role of perceived risk as a potential barrier to consumers' adoption of online shopping applications. Concerns regarding the security of personal information, the quality of products, and the reliability of delivery services may undermine users' confidence and inhibit their intention to use the apps.

Overall, Sugandini et al.'s study underscores the multifaceted nature of consumers' intentions to use online shopping applications, emphasizing the significance of perceived usefulness, ease of use, trust, social influence, and perceived risk in shaping adoption decisions. Understanding these factors is crucial for businesses and developers aiming to design and optimize online shopping apps that resonate with users and drive higher adoption rates on the Android platform.

**2021 - Abdulhaseeb H. Abdulmalik, Faisal Sulaiman A. Alghafri, and Mohammed J. Yousif - "Smart Online Grocery Shopping App Development"**

Abdulmalik, Alghafri, and Yousif's study on "Smart Online Grocery Shopping App Development" presents several significant outcomes. First and foremost, the research offers insights into the growing demand for convenient and efficient grocery shopping solutions in the digital era. By developing a smart mobile application tailored specifically for online grocery shopping, the study addresses a pressing consumer need for streamlined and user-friendly platforms in the e-commerce domain.

One of the key outcomes of the research lies in the integration of advanced technologies such as artificial intelligence (AI) and data analytics into the app development process. By harnessing AI algorithms, the smart grocery app can personalize recommendations, optimize inventory management, and enhance user experience based on individual preferences and shopping habits. This capability not only improves customer satisfaction but also increases operational efficiency for grocery retailers, leading to greater competitiveness in the online marketplace.

Furthermore, the study highlights the importance of user-centric design principles in app development. Through user feedback and iterative testing, the researchers ensure that the smart grocery app meets the needs and expectations of its target audience. Usability, accessibility, and convenience are prioritized throughout the design process, resulting in an intuitive and seamless shopping experience for consumers.

Another significant outcome of the research is the potential impact on the grocery retail industry. By introducing innovative solutions that bridge the gap between traditional brick-and-mortar stores and online platforms, the smart grocery app catalyzes digital transformation within the sector. It opens up new avenues for revenue generation, expands market reach, and fosters customer loyalty in an increasingly competitive landscape.

In conclusion, Abdulmalik, Alghafri, and Yousif's study on smart online grocery shopping app development underscores the transformative potential of technology in revolutionizing traditional retail paradigms. Through the integration of AI, data analytics, and user-centric design principles, the research offers a compelling vision for the future of grocery shopping, characterized by convenience, efficiency, and personalized service.

**Dec 2021 - Snehal Sajannavar, Jabina Dharwad, Prashant G. Tandale - "ONLINE SHOPPING – AN OVERVIEW"**

In the overview of online shopping by Sajannavar et al. (2021), several key outcomes emerge. Firstly, the study highlights the exponential growth and transformative impact of e-commerce on traditional retail paradigms. It elucidates how technological advancements, coupled with shifting consumer preferences, have fueled the proliferation of online shopping platforms.

Secondly, the research underscores the multifaceted nature of online shopping, emphasizing its diverse dimensions and implications for both consumers and businesses. From convenience and accessibility to product variety and competitive pricing, online shopping offers numerous advantages that resonate with modern consumers seeking convenience and value.

Furthermore, the overview identifies emerging trends and developments in the online retail landscape, such as the rise of mobile commerce, social commerce, and omnichannel strategies. These trends reflect the dynamic nature of e-commerce and the ongoing evolution of consumer behavior in the digital age.

Additionally, the study sheds light on the challenges and opportunities inherent in the online shopping ecosystem. Issues such as cybersecurity concerns, privacy considerations, and logistical complexities are juxtaposed with the potential for innovation, personalization, and market expansion.

Overall, the overview provides a comprehensive understanding of online shopping as a multifaceted phenomenon reshaping the global retail landscape. By synthesizing existing literature and analyzing key trends and outcomes, Sajannavar et al. offer valuable insights for researchers, practitioners, and policymakers navigating the complexities of digital commerce in the contemporary era.

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**Dec 2020 - Pavandeep Kaur, Sukhmeet Singh - "QUICKMART: AN E-COMMERCE APP FOR ONLINE SHOPPING"**

In December 2020, Pavandeep Kaur and Sukhmeet Singh introduced "QuickMart," an e-commerce application tailored to enhance online shopping experiences. The primary outcomes of their endeavor encompass several key areas:

1. Enhanced User Experience: QuickMart prioritizes user-centric design principles, resulting in an intuitive and seamless shopping interface. By prioritizing ease of navigation and efficient search functionalities, the app ensures that users can find products quickly and complete transactions with minimal friction. This focus on user experience contributes to higher levels of satisfaction and engagement among customers.

2. Personalized Recommendations: Leveraging advanced algorithms and data analytics, QuickMart offers personalized product recommendations tailored to each user's preferences and browsing history. By analyzing user behavior and purchase patterns, the app can suggest relevant items, thereby facilitating a more personalized and curated shopping experience. This personalized approach not only increases the likelihood of purchase but also fosters greater customer loyalty over time.

3. Efficient Order Fulfillment: QuickMart streamlines the order fulfillment process, ensuring timely delivery and reliable service. Through integration with logistics partners and real-time tracking capabilities, the app provides users with transparency and visibility into the status of their orders. This emphasis on efficient logistics and delivery contributes to overall customer satisfaction and reinforces trust in the platform.

4. Disruption of Traditional Retail Paradigms: By offering a convenient and user-friendly alternative to traditional brick-and-mortar stores, QuickMart contributes to the ongoing transformation of the retail landscape. The app empowers consumers to shop anytime, anywhere, thereby challenging conventional notions of retail space and opening up new opportunities for businesses to reach and engage with customers in the digital realm.

Overall, the outcomes of QuickMart demonstrate the potential of innovative e-commerce applications to redefine the way consumers interact with online stores. By prioritizing user experience, personalization, and efficiency, QuickMart sets a new standard for online shopping platforms, paving the way for enhanced customer satisfaction and business success in the digital age.

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**April 2016 - Basil Schmid, Simon Schmutz, Kay W. Axhausen - "Exploring the choice between in-store and online shopping"**

In their study "Exploring the choice between in-store and online shopping," Basil Schmid, Simon Schmutz, and Kay W. Axhausen delve into the nuanced factors driving consumers' decisions between traditional in-store shopping and the increasingly popular online shopping. Through empirical analysis and behavioral modeling, the study uncovers several key outcomes:

1. Convenience vs. Tangibility: Consumers weigh the convenience of online shopping against the tangibility and sensory experience of in-store shopping. Factors such as time constraints, transportation costs, and the desire to physically interact with products influence this choice.

2. Product Assortment and Availability: The breadth and availability of products play a crucial role in consumers' channel selection. Online platforms often offer a wider range of products and sizes, catering to diverse preferences, while physical stores may provide immediate access to specific items.

3. Price Sensitivity and Discounts: Price sensitivity emerges as a significant determinant, with consumers comparing prices between online and in-store channels. Discounts, promotions, and shipping costs further shape perceptions of value and influence shopping decisions.

4. Social Interaction and Engagement: In-store shopping offers opportunities for social interaction, assistance from sales associates, and immediate gratification. Conversely, online shopping provides convenience, anonymity, and access to user-generated reviews and recommendations.

5. Omnichannel Preferences: Consumers exhibit varying degrees of comfort and preference for omnichannel shopping experiences, blending online and offline channels to meet their needs. Retailers must understand and adapt to these preferences to optimize their omnichannel strategies.

6. Demographic and Psychographic Factors: Socio-demographic characteristics, such as age, income, and lifestyle, influence consumers' channel preferences. Younger, tech-savvy individuals may gravitate towards online shopping, while older demographics may prefer the familiarity and trust associated with in-store purchases.

**April 2021 - Seema Kashyap, Shilpa Yadav, Satyam Nigam - "Online Shopping System Multimedia system and apps"**

In the study conducted by Seema Kashyap, Shilpa Yadav, and Satyam Nigam in April 2021, the focus was on exploring the role of multimedia systems and applications in the realm of online shopping. The research aimed to investigate how various multimedia elements, such as images, videos, and interactive features, contribute to enhancing the overall shopping experience for consumers in the digital space.

One of the key outcomes of the study was the identification of the significant impact that multimedia content has on consumer engagement and purchasing behavior in online retail environments. Through the incorporation of multimedia elements, online shopping platforms can create more immersive and visually appealing experiences for users, thereby increasing their likelihood of making purchases.

Furthermore, the research highlighted the importance of leveraging multimedia technologies strategically to differentiate online shopping experiences and gain a competitive edge in the market. By providing rich and interactive content, retailers and app developers can enhance user satisfaction and loyalty, ultimately driving increased sales and revenue.

Additionally, the study underscored the need for continuous innovation and adaptation in multimedia systems and applications to keep pace with evolving consumer preferences and technological advancements. This includes exploring emerging trends such as augmented reality (AR) and virtual reality (VR) to create even more immersive and personalized shopping experiences for users.

Overall, the findings of this research contribute valuable insights for businesses and practitioners in the e-commerce industry, guiding them in effectively leveraging multimedia technologies to optimize online shopping systems and apps for enhanced consumer engagement and satisfaction.

**October 2018 - Chawla, Sushma S. - "An Analysis of Consumers Behaviour towards Online Shopping using Mobile Applications"**

Chawla's study on consumer behavior towards online shopping using mobile applications yielded several key outcomes. Firstly, the research identified perceived usefulness and ease of use as significant determinants influencing consumers' adoption of mobile shopping apps. This suggests that consumers are more likely to embrace mobile commerce platforms that offer convenience and efficiency in their shopping experience.

Secondly, the study highlighted the importance of trust in shaping consumers' attitudes towards mobile shopping applications. Factors such as security features, transparent policies, and positive user reviews contribute to building trust and confidence among mobile shoppers. Establishing trust is crucial for overcoming consumer apprehensions regarding the safety and reliability of online transactions conducted through mobile devices.

Furthermore, the research revealed insights into the factors influencing consumers' satisfaction with mobile shopping apps. Factors such as responsiveness, user interface design, and personalized recommendations play a crucial role in enhancing user satisfaction and fostering loyalty towards mobile commerce platforms. This underscores the importance of continually refining and optimizing the mobile shopping experience to meet evolving consumer expectations.

Additionally, the study shed light on the impact of demographic variables such as age, gender, and income on consumers' attitudes and behaviors towards mobile shopping applications. Understanding these demographic nuances allows businesses to tailor their mobile commerce strategies and offerings to different consumer segments effectively.

Overall, Chawla's analysis provides valuable insights into the complex interplay of factors influencing consumers' behavior towards online shopping using mobile applications. By elucidating the drivers and barriers shaping consumer attitudes and preferences in this context, the study offers practical implications for businesses aiming to design and optimize mobile commerce platforms to better meet the needs and expectations of their target audience.

# **Chapter – 3**

# **Research Methodology**

## **3.1 Detailed description of the research design**

The research design of this project, focusing on the application of machine learning (ML) in agriculture for crop recommendation and rainfall prediction, is structured to systematically explore and analyze the potential of ML algorithms in addressing these agricultural challenges. The study adopts a quantitative research methodology, leveraging a combination of descriptive and inferential statistics, to design, implement, and evaluate the effectiveness of various ML models, including Decision Trees (DT), Logistic Regression (LR), Random Forest (RF), and a Voting Classifier.

**Phase 1: Data Collection and Preparation**

The initial phase involves gathering extensive datasets from various sources, such as agricultural databases, weather stations, and satellite imagery. The data encompasses soil characteristics, historical weather patterns, and crop yield information. Rigorous data cleaning and preprocessing steps, including normalization, handling of missing values, and feature selection, are performed to ensure the quality and usability of the data for modeling purposes.

**Phase 2: Model Development and Training**

In this phase, the project develops separate models for crop recommendation and rainfall prediction using DT, LR, RF, and a Voting Classifier. Each model is trained using a portion of the dataset, with careful attention to parameter tuning to optimize performance. The choice of algorithms aims to exploit their respective strengths in capturing different aspects of the data and predicting outcomes.

**Phase 3: Evaluation and Optimization**

The models are evaluated based on their accuracy, precision, recall, and F1 score, among other relevant metrics. Cross-validation techniques are employed to assess the models' generalizability. Based on the evaluation results, models undergo further optimization to enhance their predictive performance.

**Phase 4: Integration and Testing**

Finally, the optimized models are integrated into a cohesive system designed for real-world agricultural applications. The system's performance is tested in simulated environments to assess its practicality and effectiveness in making crop recommendations and predicting rainfall with high accuracy.

This research design emphasizes a comprehensive and iterative approach to model development and evaluation, ensuring that the ML algorithms are not only theoretically sound but also practically viable in improving agricultural productivity and sustainability.

## **3.2 Explanation of the data collection process, including sources and criteria for selection**

The data collection process for our project, which focuses on the application of machine learning in agriculture, specifically for crop recommendation and rainfall prediction, hinges on acquiring high-quality, relevant datasets. For this purpose, we have chosen Kaggle as our primary source of data. Kaggle is a well-known platform that hosts a vast array of datasets provided by users worldwide, encompassing various domains, including agriculture. These datasets often come with a wealth of information, including soil properties, historical weather patterns, and crop yield data, which are integral to our research.

The criteria for dataset selection from Kaggle are meticulously defined to ensure the data's appropriateness and quality for our research objectives. The selection process involves several key steps:

* Relevance to Agricultural Variables: We prioritize datasets that include comprehensive information on soil characteristics (such as pH level, moisture content, nutrient content), weather conditions (temperature, rainfall, humidity), and historical crop yield data. These variables are crucial for developing accurate crop recommendation and rainfall prediction models.
* Data Quality and Completeness: The selected datasets must exhibit a high degree of integrity, with minimal missing values and outliers. They should also be well-documented, with clear descriptions of each variable and the data collection methodology used.
* Temporal and Geographical Representation: To ensure the models' applicability to different agricultural contexts, we look for datasets that cover a wide range of geographical locations and include data spanning multiple years. This diversity helps in developing models that are robust and adaptable to various environmental conditions and agricultural practices.
* Public Availability and Licensing: The datasets must be publicly available for research purposes and come with a license that permits their use in academic projects. This consideration ensures that our research adheres to legal and ethical standards.
* Community Feedback and Usage: Datasets with positive feedback from the Kaggle community and those used in prior successful projects are given preference. Such feedback serves as an indicator of the dataset's reliability and relevance to similar research endeavors.

By adhering to these criteria, we aim to collect a set of high-quality datasets from Kaggle that will form the foundation of our research. This meticulous selection process is critical for developing machine learning models that can provide actionable insights for agriculture, enhancing crop yields, and providing accurate rainfall predictions.

## **3.3 In-depth explanation of the machine learning algorithms used: DT, LR, RF, and the Voting Classifier**

The machine learning algorithms utilized in this project—Decision Trees (DT), Logistic Regression (LR), Random Forest (RF), and the Voting Classifier—are foundational to the development of predictive models for crop recommendation and rainfall prediction. Each algorithm has distinct characteristics and operational mechanisms that contribute uniquely to the overall predictive capability of the project.

Decision Trees (DT) are a non-linear predictive modeling tool that recursively partitions the data into subsets based on the value of input features, leading to a tree-like model of decisions. This algorithm is particularly valued for its interpretability and simplicity, as it mirrors human decision-making processes by following a series of binary choices to arrive at a prediction. DTs are flexible and can handle both numerical and categorical data, making them suitable for diverse datasets encountered in agricultural predictions.

Logistic Regression (LR), despite its name, is a linear model for classification rather than regression. It predicts the probability that a given data entry belongs to a particular category by using the logistic function to model a binary dependent variable. In the context of agriculture, LR can be instrumental in classifying whether certain conditions are suitable for a specific crop or predicting binary outcomes such as the occurrence of rain.

Random Forest (RF) enhances the decision tree model by creating an ensemble of trees and aggregating their predictions to improve accuracy and control overfitting. RF models are particularly robust and versatile, capable of performing both regression and classification tasks. Their ability to handle large datasets with a high dimensionality makes them ideal for complex agricultural data.

The Voting Classifier combines the predictions from multiple different models to form a final prediction. This ensemble method can use either a 'hard' voting strategy, where the prediction with the most votes wins, or a 'soft' voting strategy, where probabilities are averaged to determine the final output. The Voting Classifier leverages the strengths of individual models and can often achieve higher accuracy than any single model by reducing the impact of each model's weaknesses.

By integrating these algorithms, the project aims to harness their combined strengths to improve the accuracy and reliability of predictions in the agricultural domain. The careful selection and application of these ML algorithms are crucial for developing effective predictive models that can adapt to the complexities of agricultural data and provide valuable insights for decision-making.

## **3.4 Criteria for algorithm selection and their implementation**

The selection of algorithms for the project "Application of Machine Learning in Agriculture" was driven by specific criteria aimed at optimizing predictive accuracy, interpretability, and computational efficiency in the context of crop recommendation and rainfall prediction. These criteria, detailed below, informed the choice of Decision Trees (DT), Logistic Regression (LR), Random Forest (RF), and the Voting Classifier as the core methodologies for implementation.

* Predictive Accuracy: A paramount criterion for algorithm selection was the potential for high predictive accuracy. Algorithms needed to demonstrate robust performance across various datasets, including those with nonlinear relationships and high-dimensional feature spaces typical in agricultural data. RF, known for its high accuracy due to ensemble learning, and the Voting Classifier, which combines predictions from multiple models, were chosen for their superior ability to enhance prediction reliability.
* Interpretability and Transparency: For the application in agriculture, it was essential that the models provide clear insights into how predictions are made, enabling users (farmers, agronomists, researchers) to understand and trust the recommendations. DT was selected for its straightforward decision-making process, which mirrors human reasoning and allows for easy interpretation of results.
* Adaptability and Flexibility: The algorithms needed to handle a wide range of data types and structures, from numerical soil properties to categorical weather conditions. LR's ability to provide probabilistic outcomes made it valuable for binary and multiclass classification problems, while DT and RF's versatility in handling both regression and classification tasks addressed the project's diverse predictive needs.
* Computational Efficiency: Given the potentially large datasets in agricultural applications, algorithms that could operate efficiently without excessive computational resources were favored. LR, with its simplicity and speed, and DT, for its straightforward computations, met this criterion.

Implementation Approach: The implementation involved developing individual models using each selected algorithm, followed by integrating them into a Voting Classifier for combined predictions. The process entailed data preprocessing, feature selection, model training, and validation, with an iterative approach to tuning and optimizing each model's parameters to achieve the best possible performance. This strategic selection and implementation of algorithms were geared towards developing a comprehensive machine learning solution capable of addressing the complexities and nuances of agricultural prediction tasks.

## **3.5 Explanation of the data preprocessing steps**

Data preprocessing is a critical step in any machine learning project, ensuring that the dataset is clean, consistent, and ready for analysis. For the project "Application of Machine Learning in Agriculture," focusing on crop recommendation and rainfall prediction, the preprocessing involved several key steps to optimize the data for the selected machine learning algorithms: Decision Trees (DT), Logistic Regression (LR), Random Forest (RF), and the Voting Classifier.

* Data Cleaning: The initial phase involved removing or correcting erroneous or irrelevant data points. This step was crucial to eliminate noise and prevent the introduction of bias into the models. For instance, entries with missing values for essential variables like rainfall or soil pH were addressed either by removing the entry or imputing values based on relevant criteria, such as the mean or median of that variable.
* Feature Selection: Given the vast array of factors that can influence crop growth and weather patterns, identifying the most relevant features was essential. This process reduced the dimensionality of the dataset, improving model performance and computational efficiency. Techniques such as correlation analysis and importance ranking via preliminary models helped identify key predictors like temperature, soil type, and historical rainfall patterns.
* Data Transformation: Certain algorithms perform better when the data conforms to a specific distribution. Therefore, transformations such as normalization or standardization were applied to numerical variables to bring all features to a comparable scale, enhancing the stability and convergence speed of the models.
* Encoding Categorical Variables: Many machine learning models require numerical input; thus, categorical variables such as soil type or crop category were encoded using methods like one-hot encoding. This step converted categorical data into a format that could be effectively processed by the algorithms.
* Data Splitting: Finally, the dataset was divided into training and testing sets. This separation allowed for the validation of model performance on unseen data, ensuring that the models could generalize beyond the specific examples they were trained on.

These preprocessing steps were foundational to the project, enabling the development of accurate and reliable predictive models for enhancing agricultural practices through machine learning.

## **3.6 Implementation details of the crop recommendation and rainfall prediction models**

The implementation of the crop recommendation and rainfall prediction models within the "Application of Machine Learning in Agriculture" project was structured to optimize the use of Decision Trees (DT), Logistic Regression (LR), Random Forest (RF), and the Voting Classifier. These models were developed and refined through a systematic process, leveraging a curated dataset from Kaggle that included variables such as soil characteristics, historical climate data, and crop yield outcomes. The implementation details for each model component are as follows:

Crop Recommendation Model:

* + Data Inputs: Included soil pH, moisture content, nutrient levels, and historical yield data. These features were selected based on their importance in influencing crop growth outcomes.
  + Model Selection: RF was primarily used for its ability to handle the complexity and variability of agricultural data, complemented by DT for its interpretability in determining the factors most influencing crop recommendations.
  + Training Process: The model was trained on a split dataset, with 80% used for training and 20% for validation, ensuring the model's ability to generalize to new data.
  + Performance Evaluation: Accuracy, precision, and recall metrics were utilized to fine-tune the model, aiming for the highest predictive accuracy while maintaining the ability to correctly identify the most suitable crops for given soil conditions.

Rainfall Prediction Model:

* + Data Inputs: Incorporated temperature, humidity, barometric pressure, and historical rainfall patterns. These variables were critical in predicting precipitation events.
  + Model Selection: A combination of LR for its efficiency in binary outcomes (e.g., rain or no rain) and RF for its robustness in dealing with temporal data. The Voting Classifier was then applied to integrate these models, enhancing prediction accuracy through ensemble learning.
  + Training Process: Similar to the crop recommendation model, a data split of 80% training and 20% validation was used. Time series cross-validation was also considered to account for the temporal nature of rainfall data.
  + Performance Evaluation: Metrics such as the F1 score and ROC-AUC were key in assessing model performance, with a focus on the model's sensitivity and specificity in accurately predicting rainfall events.

Throughout the implementation, a focus on data preprocessing ensured that both models received clean, normalized, and relevant inputs, enhancing the predictive capabilities of the chosen machine learning algorithms. These implementation details highlight the project's comprehensive approach to leveraging advanced analytics in addressing critical challenges in agriculture.

# **Chapter – 4**

# **Implementation**

**Customer Interface (UI) and Experience (UX):**

A seamless and intuitive user interface (UI) combined with a positive user experience (UX) is essential for any e-commerce platform. Intuitive navigation ensures that customers can effortlessly find the products they are looking for and smoothly navigate through the website or application. Clear product descriptions play a crucial role in helping customers make informed purchasing decisions by providing detailed and accurate information about the products. Additionally, a streamlined checkout process minimizes friction and makes it easy for customers to complete their purchases swiftly, enhancing overall satisfaction.

**Product Listing and Catalogs Management:**

Offering a comprehensive product listing and effective catalog management is imperative for facilitating a convenient shopping experience. Customers should be able to easily view the available products or services, browse through them, and find specific items of interest. Implementing a search functionality enables customers to quickly locate desired products, while providing filters allows them to narrow down their search based on various criteria such as price, category, or brand, thereby enhancing usability and convenience.

**Shopping Cart and Delivery:**

The shopping cart and delivery process should be smooth and efficient to ensure a hassle-free shopping experience. Customers should be able to add items to their cart for future purchase and easily update its contents by adjusting quantities or removing items as needed. Offering various delivery options and allowing customers to choose their preferred shipping method caters to their individual preferences and enhances flexibility in the checkout process.

**Customer Accounts and Profiles:**

Allowing customers to create accounts and manage their profiles is essential for personalization and convenience. Customers should be able to register accounts to access additional features, save their preferences, and expedite future purchases. Providing a secure login/logout mechanism enables customers to access their accounts safely, while a profile page allows them to manage personal information and settings. Moreover, allowing customers to view their order history and track their purchase history enhances transparency and facilitates efficient order management.

**Order Management and Tracking:**

Efficient order management and tracking mechanisms are crucial for providing visibility and transparency throughout the order fulfillment process. Customers should be able to securely place orders and receive real-time updates on the status of their orders, from processing to delivery. Allowing customers to track the progress of their orders in transit until they are delivered provides peace of mind and enhances trust in the platform.

**Review and Ratings:**

Customer reviews and ratings play a significant role in influencing purchase decisions and fostering trust among potential buyers. Displaying product reviews and ratings from other customers helps inform purchase decisions by providing insights into product quality and performance. Additionally, allowing customers to leave feedback and ratings for products they have purchased not only contributes to the community’s knowledge but also helps other customers make informed decisions, thereby fostering a sense of community and trust within the platform.

**Security and Privacy:**

Ensuring robust security measures and respecting customer privacy are paramount for building trust and credibility. Customers should be empowered to manage their account security settings, such as changing passwords or enabling two-factor authentication, to enhance account protection. Providing options to manage privacy preferences, such as opting out of promotional emails or controlling data sharing preferences, demonstrates respect for customer privacy and helps build trust in the platform's commitment to data security and privacy protection.

**Admin Modules:**

**Product Management:**

In any e-commerce platform, efficient product management is paramount for offering a seamless shopping experience. Administrators must have the capability to add, edit, and delete products swiftly, ensuring that the product catalog remains up-to-date. Moreover, managing product categories allows for better organization and navigation within the inventory, facilitating smoother browsing for customers. By streamlining product management processes, administrators can maintain a well-curated and organized selection of items, ultimately enhancing the overall user experience.

**Order Management:**

Efficient order management is vital for ensuring timely order processing and delivery. Administrators should have the ability to view and update order status in real-time, allowing them to track orders from placement to fulfillment accurately. This not only enables administrators to monitor the progress of individual orders but also helps in resolving any issues that may arise during the process. By maintaining a streamlined order management system, administrators can uphold customer satisfaction by ensuring prompt delivery and effective communication regarding order status.

**Customer Management:**

Accessing comprehensive customer details, including order history and preferences, empowers administrators to provide personalized assistance and support. By understanding customers' past interactions with the platform, administrators can tailor their responses to inquiries, offer targeted recommendations, and address any concerns effectively. This personalized approach fosters stronger relationships with customers and enhances their overall satisfaction, ultimately leading to increased loyalty and repeat business.

**Feedback and Ratings Management:**

Monitoring customer feedback and product ratings is crucial for gauging customer satisfaction and identifying areas for improvement. By actively monitoring and analyzing feedback, administrators can gain valuable insights into customer preferences, product performance, and areas needing enhancement. This allows for timely adjustments and optimizations to be made, ensuring that the platform continues to meet the evolving needs and expectations of its user base.

**User Authentication and Authorization:**

Effective user authentication and authorization mechanisms are essential for safeguarding user accounts and sensitive information. Administrators must manage user roles and permissions meticulously to ensure that access levels are appropriate and aligned with users' responsibilities. This not only enhances platform security by preventing unauthorized access but also fosters trust and confidence among users, knowing that their data is protected against potential security threats.

**Security and Privacy Management:**

Implementing robust security measures is paramount for protecting user data and maintaining the privacy of sensitive information. Administrators should employ encryption protocols, secure authentication methods, and regular security audits to mitigate the risk of data breaches and unauthorized access. By prioritizing security and privacy management, administrators can instill trust and reliability in the platform, reassuring users that their personal information is handled with the utmost care and diligence.

# **Chapter – 6**

# **Conclusion**

## **6.1 Conclusion**

The evolution of online shopping applications has revolutionized the retail landscape, with a strong focus on enhancing user experience and optimizing transactions. A pivotal aspect of this evolution is the meticulous attention given to intuitive User Interface (UI) and User Experience (UX) design. This prioritization ensures easy navigation, transparent product descriptions, and a streamlined checkout process, fostering a seamless user journey.

Integral to this transformation is the implementation of robust Product Listing and Management systems, which provide comprehensive product details, high-quality images, and efficient search filters, enabling swift item discovery. Moreover, functionalities such as Shopping Cart and Delivery mechanisms prioritize secure transactions and offer diverse payment options, catering to varying customer preferences.

User Accounts and Profiles play a crucial role in personalizing the shopping experience, allowing customers to save preferences and track order history securely. Effective Order Management and Tracking further enhance user satisfaction by providing real-time updates on order status, ensuring smooth order fulfillment and delivery.

Promotions and discounts, including coupons and loyalty programs, serve as powerful tools to attract and retain customers. Additionally, Review and Ratings systems promote transparency and aid purchasing decisions by enabling customers to provide feedback and share their experiences.

Responsive Customer Support across multiple channels ensures prompt query resolution, enhancing overall satisfaction. Emphasis on Security and Privacy safeguards sensitive user data and ensures compliance with regulations, fostering trust and confidence among users.

## **6.2 Future Scope**

The business scope of an online shopping application encompasses a multitude of processes aimed at delivering a seamless and satisfying shopping experience to customers. This entails crafting an intuitive user interface with visually appealing design elements that facilitate easy navigation through a diverse range of products, accompanied by detailed descriptions and specifications. Crucially, stores must possess robust search capabilities and effective filters to enable users to swiftly locate desired items.

Key features include ensuring security throughout the shopping cart and implementing a versatile payment system that offers various options for user convenience. The application should facilitate quick and efficient ordering and management, while also incorporating promotional offers, discounts, and loyalty programs to enhance user engagement and retention.

Moreover, stringent security measures, such as encryption protocols, are imperative to safeguard user data and foster trust. The application must also be optimized for compatibility across different devices, possess global reach capabilities, and have the flexibility to integrate emerging technologies like augmented reality to enrich the purchasing experience.

Continuous innovation, adaptation to evolving business trends, and a relentless focus on user-centricity are fundamental aspects of the overall functionality and success of online shopping applications. By prioritizing these elements, businesses can effectively meet the dynamic needs and expectations of modern consumers in the digital marketplace.

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