

BAYER BUY - Ecommerce Website

A PROJECT REPORT

Submitted by

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MASTER OF COMPUTER APPLICATION



**Thangal Kunju Musaliar College of Engineering
Kerala**

DEPARTMENT OF COMPUTER APPLICATION

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DECLARATION

I undersigned hereby declare that the project report on **BAYER BUY - Ecommerce Website**, submitted for partial fulfillment of the requirements for the award of degree of Master of Computer Application of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under supervision of **Prof. Vaheetha Salam**. This submission represents my ideas in my own words and where ideas or words of others have been included, I have adequately and accurately cited and referenced the original sources. I also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in our submission. I understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not previously served as the basis for the award of any degree, diploma, or similar title by any other University.

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CERTIFICATE

This is to certify that the report entitled **BAYER BUY - Ecommerce Website** submitted by **Arun S Nair** (TKM21MCA-2010) to the APJ Abdul Kalam Technological University in partial fulfillment of the Masters degree in Computer Application is a bonafide record of the project work carried out by him under our guidance and supervision. This report, in any form, has not been submitted to any other University or Institute for any reason.

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ABSTRACT

BAYER BUY - Ecommerce Website

Bayer Buy is an innovative e-commerce website that aims to empower farmers by providing them with a wide range of farming aids and seeds. As a subsidiary of Bayer Crop Science, a global leader in agricultural products, Bayer Buy builds upon the company's rich history of innovation and commitment to supporting farmers in growing healthy crops. The website offers a comprehensive selection of products, including fertilizers, pesticides, herbicides, and seeds, along with valuable services such as crop consulting and crop insurance.

Convenience is at the core of Bayer Buy's mission. By operating as an online platform, farmers can easily access the website from anywhere, making it a convenient solution for their agricultural needs. The user-friendly interface ensures that farmers can quickly find the products and services they require to cultivate a successful crop.

With Bayer Crop Science's expertise and reputation, Bayer Buy guarantees the reliability of its offerings. Farmers can trust the quality and effectiveness of the products and services available on the platform. Furthermore, Bayer Buy provides a wide selection of options, catering to the diverse needs of farmers of all sizes. This comprehensive range allows farmers to find the specific products and services that best suit their unique requirements.

By combining the convenience of online shopping, the reliability of Bayer Crop Science's expertise, a wide selection of products and services, competitive pricing, and dedicated customer support, Bayer Buy becomes a valuable resource for farmers seeking to optimize their crop cultivation practices.

If you are a farmer, I encourage you to explore the benefits of Bayer Buy. It serves as a reliable and convenient platform, connecting you with the agricultural products and services necessary for a successful harvest. With Bayer Buy, you can enhance your farming practices, streamline your procurement process, and ultimately achieve greater success in your agricultural endeavors.

Contents

List of Figures	iv
1 Introduction	1
1.1 Company Profile	2
1.1.1 Products	3
1.1.2 Services	4
1.2 Existing System	5
1.3 Proposed System	6
1.4 Objectives	7
2 Literature Survey	9
2.1 Purpose of the Literature Review	9
2.2 Related Works	10
2.2.1 Digital Commerce Insights: Analyzing Consumer Adoption and Cross-Platform Recommendations	10
2.2.2 Mobile e-Commerce Technology	13
2.2.3 Rest Api	14
2.2.4 RestAPI Authentication	15
2.2.5 Springboot	16
2.2.6 Java	17
2.2.7 MySQL	18

2.2.8	Difference between MySQL and MongoDB	20
2.2.9	React	22
3	Methodology	24
3.1	Key Features of Bayer Zone	25
3.2	Module Description	26
3.2.1	User Management Module	26
3.2.2	Product Management Module	27
3.2.3	Scheduler	27
3.3	System Specifications	28
3.3.1	Hardware Requirements	28
3.3.2	Software Requirements	28
3.3.3	Software Description	29
3.4	System Design	31
3.4.1	System Architecture	32
3.4.2	Module Design	33
4	Result And Discussion	35
4.1	Testing Methods	36
4.1.1	Functionality Testing	36
4.1.2	Unit Testing	38
4.1.3	User Acceptance Testing	38
4.1.4	Sample Test Cases	39
4.2	Output Screens and Results	41

5 Conclusion	44
5.1 Future Enhancement	45
References	47
Appendix	50

List of Figures

3.1	HLD diagram of the system	25
3.1	User Interaction in Login and Registration	26
4.1	Sample Test sheet for the Registration Functionality	40
4.2	User Home Page	41
4.2	Information on single product	42
4.3	Continuation of the description of the product	43
5.1	Registration Page	50
5.2	Login Page	50
5.3	Home Page of the Application	51
5.4	Users Home Page	51
5.5	Users Home Page(Mobile View)	52
5.6	Single Product Description Page	52
5.7	Single Product Description Page(Mobile View)	53

Chapter 1

Introduction

The agricultural sector plays a vital role in ensuring food security and economic stability in countries around the world. With the advancement of technology, the farming industry has seen significant transformations in recent years, with a growing emphasis on efficiency, sustainability, and access to modern tools and aids. In line with these developments, we present **"BAYER BUY - Ecommerce Website"** catalog specifically designed to cater to the needs of farmers by offering a wide range of farming aid products.

BayerBuy is a comprehensive platform developed using cutting-edge technologies such as Spring Boot, React, and MySQL, aimed at simplifying the process of procuring farming aids for agricultural enthusiasts and professionals. This project report serves as a detailed account of the development process, features, and functionalities of BayerBuy, shedding light on its significance and potential impact in the farming community.

By leveraging the power of Spring Boot, a Java-based framework, BayerBuy ensures robustness, scalability, and enhanced performance. The integration of React, a popular JavaScript library, empowers the platform with a dynamic and user-friendly interface, providing an intuitive browsing and shopping experience for farmers. The utilization of MySQL as the underlying database management system guarantees efficient data storage and retrieval, enabling seamless product management and inventory control.

The primary objective of BayerBuy is to bridge the gap between farmers and essential farming aid products. Through this platform, farmers can conveniently explore, compare, and purchase a wide array of agricultural tools, fertilizers, pesticides, machinery, and other essential supplies. With a user-friendly interface and advanced search functionalities, BayerBuy simplifies the product discovery process, allowing farmers to find the most suitable solutions for their specific requirements.

Furthermore, BayerBuy aims to promote sustainable and eco-friendly practices in agri-

culture. The platform includes a dedicated section for organic and environmentally friendly farming aids, encouraging farmers to adopt more sustainable approaches to crop cultivation. By facilitating access to such products, BayerBuy contributes to the overall development of a more sustainable and environmentally conscious farming community.

In this project report, we will delve into the technical aspects of BayerBuy, including the architecture, data modeling, API integrations, and security measures. Additionally, we will explore the potential future enhancements and scalability options for BayerBuy, highlighting its potential for growth and expansion in the ever-evolving agricultural market.

BayerBuy represents a significant step forward in the digitization of the agricultural industry, providing farmers with a reliable and user-friendly platform to access farming aid products conveniently. The amalgamation of Spring Boot, React, and MySQL ensures a robust, efficient, and scalable solution. With its potential to empower farmers and promote sustainable practices, BayerBuy aims to contribute to the growth and prosperity of the farming community.

1.1 Company Profile

Bayer CropScience is a global leader in the development, production, and marketing of crop protection products. Bayer CropScience operates at the intersection of science, technology, and agriculture, aiming to enhance crop productivity, protect crops from pests and diseases, and promote sustainable farming practices. The company's diverse product portfolio encompasses seeds, crop protection solutions, digital farming tools, and agricultural services, making it a holistic provider of solutions across the entire agricultural value chain.

With a presence in over 120 countries, Bayer CropScience serves farmers across the globe, catering to diverse cropping systems and agricultural practices. The company's commitment to innovation is evident through its extensive research and development efforts, which focus on developing cutting-edge technologies, traits, and formulations to address emerging challenges in agriculture.

1.1.1 Products

- **FarmRise**

FarmRise is a digital platform for Android mobile devices. It provides agronomic information and advice relevant to smallholder farmers, helping you make informed decisions to reduce costs, increase yield and get better price for your output. FarmRise provides you with agriculture information in multiple languages that is timely, trusted and accurate.

Aspects of Farmrice:

1. Market Pricing of each crops
2. Agronomic Advice by crop
3. Information on Government Schemes
4. Wheather Information
5. Agricultural News and Events

- **FieldView**

Bayer's FieldView is a digital platform that combines field-level data, satellite imagery, and weather information to provide farmers with actionable insights for precision farming. It enables farmers to monitor crop health, analyze field variability, and make informed decisions regarding planting, irrigation, fertilization, and crop protection.

- **Xarvio**

Xarvio digital farming solutions are designed to empower farmers with actionable insights, enabling them to make data-driven decisions and adopt more precise and sustainable farming practices. By leveraging Xarvio's advanced technologies and data-driven approach, farmers can proactively manage risks, optimize crop inputs, and mitigate environmental impact, fostering a more sustainable and resilient agricultural system. The integration of Xarvio's digital farming solutions into their operations equips farmers with the tools they need to stay ahead in a rapidly evolving and increasingly complex farming landscape, ultimately leading to improved productivity and profitability.

1.1.2 Services

- **Data to Drive Decisions**

What we at Bayer call digital farming is the same farming humans have done for millenia, but better. Farmers combine on-the-ground insights into their own operations, aggregated data from satellites and third parties, and cutting-edge machine learning techniques to understand what's happening in their fields better than ever before. And they have the flexibility to integrate tools that drive even better ways to manage their operations, from remote sensors that detect and diagnose yield-impacting field issues, to unmanned aerial vehicles (UAVs, commonly referred to as "drones"), that help image and treat those issues. And innovative science pipelines are continually developing new ways to understand and partner with farmers to provide the solutions they need, when they're needed.

- **Developing precision agriculture technologies**

Precision agriculture technologies use sensors and other data to collect information about crops, such as their health, growth, and nutrient levels. This information can then be used to make decisions about things like when to plant, water, and fertilize crops. Precision agriculture can help farmers to reduce their use of pesticides and fertilizers, while also increasing their yields.

- **Agronomy Service**

Agronomy services are a range of services that are provided to farmers to help them improve their crop production. These services can include soil testing, crop planning, pest and disease management, and irrigation management. Agronomy services can help farmers to increase their yields, reduce their costs, and improve the sustainability of their operations all through analysis and using of existing and newly collected data.

- **Supply chain management**

Digital solutions can also play a crucial role in managing the agricultural supply chain. By providing real-time visibility into crop yields, quality, and distribution, farmers can make better decisions about logistics and distribution, reducing waste and improving efficiency. Supply chain management tools can also help farmers better understand market demand, negotiate better prices, and improve their overall profitability.

1.2 Existing System

Existing systems are sometimes intricate and challenging to comprehend and manage. It involves traditional brick-and-mortar stores, agricultural supply businesses, and trade exhibits. Farmers and growers typically rely on these channels to purchase agricultural goods and services. This sales model often requires farmers to travel long distances to obtain the necessary products, which can be time-consuming and inefficient.

Within this system, mediators play a crucial role. These intermediaries act as go-betweens, connecting the brick-and-mortar stores and the customers. They facilitate transactions, provide value-added services, and assist in the overall buying process. However, their involvement can lead to certain drawbacks.

One of the challenges of the existing system is the increased costs associated with mediators. These intermediaries add an extra layer to the supply chain, which can result in higher prices for the end consumers. Additionally, companies may have reduced control over their products and customer interactions, as the mediators act as the main point of contact.

Furthermore, the presence of mediators can sometimes lead to potential delays in the shopping experience. As farmers and growers have to rely on these intermediaries, any inefficiencies or bottlenecks in the process can slow down the procurement of goods and services.

The traditional sales model also has limitations when it comes to providing access to a diverse range of products, services, and educational materials. Farmers often have to rely on their own knowledge or seek assistance from sales staff, which may not always yield the best results. This lack of easy access to a wide variety of resources can hinder farmers' ability to make informed decisions and optimize their operations.

Moreover, the existing system has limited capabilities in promoting cooperation and information exchange among producers. Farmers may miss out on networking opportunities, sharing best practices, and staying updated on emerging technologies and market developments. This lack of collaboration can impede the industry's overall progress and hinder the adoption of innovative practices.

In summary, the current system in the agriculture industry involves traditional brick-

and-mortar stores, agricultural supply businesses, and trade exhibits. Mediators act as intermediaries, facilitating transactions between the stores and the customers. However, the involvement of mediators can result in increased costs, reduced control for companies, potential delays, limited access to resources, and a lack of collaboration among producers.

1.3 Proposed System

The proposed system in the agriculture industry aims to revolutionize the current structure by reducing the reliance on mediators and transitioning towards a company-controlled online front. This system leverages digital technologies and online platforms to create a more efficient, accessible, and interconnected ecosystem for farmers, growers, companies, and customers.

By embracing digital platforms, companies can establish their own online marketplaces and e-commerce platforms. These platforms serve as centralized hubs where customers can directly interact with the company, browse products, make purchases, and access value-added services. This provides companies with greater control over branding, product listings, pricing, and customer interactions, resulting in personalized shopping experiences, improved customer service, and faster response times.

Reducing the involvement of intermediaries allows companies to offer more competitive pricing by eliminating the additional costs associated with third-party mediation. Customers benefit from potentially lower prices for agricultural goods and services, as well as the convenience of direct communication with the company. The proposed system empowers companies to selectively engage with trusted partners such as logistics providers, payment gateways, or marketing agencies to enhance their online operations, giving them flexibility and control over their online presence.

For farmers and growers, the proposed system provides access to online marketplaces and e-commerce platforms designed specifically for the agriculture industry. This eliminates the need for extensive travel and allows farmers to easily browse, compare, and purchase a wide variety of agricultural products, services, and educational resources from the convenience of their homes or farms. Farmers also benefit from networking opportunities, knowledge exchange, and collaboration through online communities, forums, and social networks. This fosters

innovation, efficiency, and informed decision-making based on collective expertise.

Here are some of the benefits of a proposed system:

- **User-Friendly catalogue:** A user-friendly catalog is a key component of the proposed system in the ecommerce industry. It refers to a well-organized and intuitive display of products or services that makes it easy for users to browse, search, and find the items they are interested in.
- **More Control for the company:** By coming to the online front the control is shifted back to the company itself by reducing the reliance on mediators.
- **Reduced expenses:** From the brick and mortar to the online system, it would reduce the need of intermediate warehouses and stores thereby reducing the cost of such expenses.
- **Increased security:** By preventing unauthorised access to data and systems, a suggested solution might contribute to an organization's increased security.
- **Customer Experience:** Elimination of time-consuming travels for farmers to acquire necessary supplies.

1.4 Objectives

Project deliverable includes:

- To create a comprehensive online catalog of agricultural products and services that is easily accessible to farmers and growers.
- to create an online shopping platform that enables people to purchase goods while offering a simple and easy experience.
- To provide farmers with a wide range of agricultural products and services, including seeds, crop protection products, and agronomic solutions.
- To provide farmers with access to information and resources that can help them improve their yields and quality.

- By offering a practical and user-friendly platform for buying agricultural supplies and getting access to educational materials, we want to increase the productivity and profitability of farming operations.
- Can provide a platform for farmers, researchers, and other stakeholders to collaborate on agricultural research and development. This can help to accelerate the development of new and innovative agricultural solutions.

Chapter 2

Literature Survey

A literature survey, also known as a literature review, involves analyzing scholarly sources related to a particular subject. Examining the available literature, it provides a comprehensive overview of the state of the field, allowing you to identify relevant theories, approaches, and gaps in the existing body of knowledge. When conducting a literature review from an audit perspective, the main focus is on evaluating the relevant literature. This process covers information that has been published in a specific field of study and sometimes includes information published within a specific time frame. The literature review is an indispensable tool for conducting research and is frequently used as a starting point for delving into a specific subject area. In addition to identifying important theories and concepts, a literature review can also pinpoint gaps in current knowledge and draw attention to areas where further research is necessary. By scrutinizing multiple sources, a literature review can provide a more comprehensive understanding of a given topic or issue. A well-crafted literature review can also enhance the credibility and authority of the author, as it demonstrates their familiarity with the current research and debates in the field. In certain cases, a literature review may include a meta-analysis, which involves analyzing the findings of numerous studies to uncover common patterns or trends. It is important to keep in mind that a literature review is distinct from a research paper or an argumentative essay; it is instead a focused examination of the existing research and literature on a specific topic.

2.1 Purpose of the Literature Review

1. The purpose of a literature review is to provide an overview and analysis of existing research and literature on a particular topic.
2. It aims to identify key theories, concepts, and findings, as well as to evaluate the strengths

and weaknesses of previous studies.

3. A literature review can help to identify gaps in the current knowledge and highlight areas where further research is needed.
4. By examining multiple sources, a literature review can provide a more comprehensive understanding of a particular topic or issue.
5. Additionally, a well-written literature review can help to establish the credibility and authority of the author, as it demonstrates their familiarity with the current research and debates in the field.
6. A literature review can be a standalone piece or part of a larger research project such as a thesis, dissertation, or research paper.
7. A literature review allows for the integration of diverse perspectives and approaches within a specific field.
8. By critically evaluating existing literature, researchers can identify areas that have not been extensively studied or where contradictory findings exist.

2.2 Related Works

2.2.1 Digital Commerce Insights: Analyzing Consumer Adoption and Cross-Platform Recommendations

E-commerce, also known as electronic commerce or internet commerce, refers to the exchange of money and data for the purpose of business operations through the internet. The term “ecommerce” is commonly used to refer to the online sale of tangible goods, but it may also refer to any type of commercial transaction made possible via the internet. It is nowadays one of the most important components of the internet. Electronic commerce is the process of conducting business using computer networks. An individual sitting in front of a computer may use all of the Internet’s resources to purchase or sell things. E-commerce, which began in the early 1990s, has made enormous strides in the world of computers. B2B e-commerce is used to increase the usage of ecommerce in developing nations by enhancing access to global

markets for enterprises in developing countries. Regardless of the rapid growth of technology, e-commerce has reached its apex. This article proposes a novel application concept. It describes the public's needs for M-Commerce, as well as the analysis and literacy survey of essential components of mobile devices that use such apps. The design and security of the application are both carefully studied. This study examines the characteristics and possibilities of a mobile E-app for selling and purchasing fresh vegetables. The outcomes demonstrate how the application has impacted the public, employment, and long-term growth.[1].

Social e-commerce, as a new concept of e-commerce, uses social media as a new prevalent platform for online shopping. Users are now able to view, add to cart, and buy products within a single social media app. In this paper, we address the problem of cross-platform recommendation for social ecommerce, i.e., recommending products to users when they are shopping through social media. To the best of our knowledge, this is a new and important problem for all e-commerce companies (e.g., Amazon, Alibaba), but it has never been studied before. Existing cross-platform and social-related recommendation methods cannot be applied directly to this problem since they do not co-consider the social information and the cross-platform characteristics together. To study this problem, we collect two real-world datasets from social e-commerce services. We first investigate the heterogeneous shopping behaviors between traditional e-commerce app and social media. Based on these observations from data, we propose CROSS (Cross-platform Recommendation for Online Shopping in Social Media), a recommendation framework utilizing not only user-item interaction data on both platforms, but also social relation data on social media. The framework is general, and we propose two variants, CROSS-MF and CROSS-NCF. Extensive experiments on two real-world social e-commerce datasets demonstrate that our proposed CROSS significantly outperforms existing state-of-the-art methods. Social e-commerce is a new concept of e-commerce that uses social media as a platform for online shopping. Cross-platform recommendation is the problem of recommending products to users when they are shopping through social media. Existing cross-platform and social-related recommendation methods cannot be applied directly to this problem since they do not co-consider the social information and the cross-platform characteristics together. We propose CROSS, a recommendation framework that utilizes both user-item interaction data on both platforms and social relation data on social media. We conduct extensive experiments on two real-world social e-commerce datasets and show that CROSS significantly outperforms existing state-of-the-art methods.[2].

Currently, booking airline tickets through online platforms is more popular than buying from travel agents, especially for Indonesian Gen Z, who were born and grew up with technology. However, research on the adoption of online platforms has been conducted separately for e-commerce and airline applications. This study aims to analyze both. This study found that UTAUT 2 is a successful model for analyzing consumer adoption behavior. The results showed that the adoption value for e-commerce was higher than airline applications, at 4.38 and 1.62, respectively. However, all respondents had used both types of platforms, albeit with different frequencies. The descriptive analysis of each instrument showed that the "Price Value" factor is the most prominent for airline applications, and the "Habit" factor is the most powerful for e-commerce. These results can be used by stakeholders to improve the quality of their services. UTAUT 2 is a successful model for analyzing consumer adoption behavior. UTAUT 2 is a theory of acceptance and use of technology that was developed in 2009. It is a comprehensive model that takes into account a variety of factors that influence consumer adoption of technology, including performance expectancy, effort expectancy, social influence, facilitating conditions, and behavioral intention. The results of this study support the validity of UTAUT 2 as a model for understanding consumer adoption of online platforms. The adoption value for e-commerce was higher than airline applications. This finding suggests that consumers are more likely to adopt e-commerce platforms than airline applications. There are a number of possible explanations for this finding. One possibility is that e-commerce platforms offer a wider range of products and services than airline applications. Another possibility is that e-commerce platforms are easier to use than airline applications. Finally, it is also possible that consumers are more familiar with e-commerce platforms than airline applications. All respondents had used both types of platforms, albeit with different frequencies. This finding suggests that consumers are using both online platforms and travel agents to book airline tickets. This is likely due to the fact that each type of platform has its own advantages and disadvantages. For example, online platforms may offer lower prices, while travel agents may offer more personalized service. The "Price Value" factor is the most prominent for airline applications. This finding suggests that price is a key factor in consumers' decision to use airline applications. This is likely due to the fact that airline tickets can be expensive. Consumers may be more likely to use an airline application if it offers lower prices. The "Habit" factor is the most powerful for e-commerce. This finding suggests that habit is a key factor in consumers' decision to use e-commerce platforms. This is likely due to the fact that

ecommerce platforms are often used for everyday purchases. Consumers may be more likely to use an e-commerce platform if they are already familiar with it and if they have a positive experience using it.[3].

2.2.2 Mobile e-Commerce Technology

With the evolution of mobile networks from 2.5G to 3G, the development of e-commerce to mobile e-commerce has contributed to the fact that mobile e-commerce will be an important part of future mobile applications. This paper introduces in detail the advantages and disadvantages of core technologies that have appeared in recent years that support the development of mobile ecommerce, and analyzes the mobile e-commerce system based on the J2ME development platform, which provides Internet Protocol support such as HTTP and TCP and ensures that communication terminals can steadily and reliably access all information on the Internet. Further studies will focus on the security problems that generally exist in the mobile e-commerce system and the solutions to these problems. Mobile e-commerce is becoming increasingly important as mobile networks evolve. There are a number of core technologies that support the development of mobile e-commerce. The J2ME development platform is a popular choice for developing mobile e-commerce applications. Mobile e-commerce systems face a number of security challenges. Further research is needed to address these security challenges.[4]. Due to the rapid increase of mobile users and the in-depth development of mobile communication technology, mobile e-commerce has developed rapidly. A hundred billion industry ecosystem is becoming visible. It is one of the hottest applications for transactions in today's retail industry. In this paper, we mainly describe some important issues in the mobile commerce ecosystem. First, we explain what is mobile e-commerce ecosystem, then analyze its participants, elaborate on the hierarchical relationship beyond the participants, and finally analyze the growth model of mobile ecommerce from the perspective of the ecological angle that launches its evolution path. The purpose is to understand how mobile e-commerce evolves. Mobile e-commerce is a rapidly growing industry. Mobile e-commerce has a significant impact on the retail industry. The mobile e-commerce ecosystem is complex and has many participants. The growth of mobile e-commerce is driven by a number of factors, including the increasing number of mobile users and the development of mobile communication technology. The future of mobile e-commerce is promising and has the

potential to revolutionize the retail industry.[5].

2.2.3 Rest Api

A REST API (Representational State Transfer API) is an application programming interface (API) that conforms to the constraints of the REST architectural style. REST stands for representational state transfer and was created by computer scientist Roy Fielding. REST APIs are used to expose functionality of a software application or web service to other software applications. They are typically used to transfer data between clients and servers. REST APIs are based on the following principles which are resources, Everything in a REST API is a resource. A resource can be a physical object, such as a customer or an order, or it can be an abstract concept, such as a transaction or a report. URIs, Each resource is identified by a unique URI (Uniform Resource Identifier). URIs are used to access resources in a REST API. HTTP verbs, REST APIs use HTTP verbs to define the actions that can be performed on resources. The most common HTTP verbs are GET, POST, PUT, and DELETE. Hypermedia, REST APIs use hypermedia to allow clients to navigate between resources. Hypermedia is typically provided in the form of links in the response body. The DREST architectural style has become a popular choice for distributed resources, such as the northbound API of software-defined networking (SDN). However, as services often change and update frequently, the corresponding REST APIs need to change and update accordingly. This can be a challenge, as it can break clients that are expecting a specific API structure. To address this issue, this paper proposes a new approach to designing REST APIs that are more flexible and extensible. The proposed approach uses a Petri-Net-based framework called REST Chart to describe the structure of the API. REST Chart makes it easy to add new resources and relationships to the API without breaking existing clients. The proposed approach also includes a client-side differential cache mechanism to reduce the overhead of hypertext-driven navigation. The cache mechanism stores a copy of the API structure on the client, which can be used to quickly look up resources and relationships. This reduces the number of requests that need to be made to the server, which can improve performance. The proposed approach has been evaluated in a number of SDN applications. The results show that the proposed approach can reduce the overhead of hypertext-driven navigation by up to 66 percentage, while still maintaining the desired flexibility and extensibility of the REST API. Flexibility: REST Chart makes it easy to

add new resources and relationships to the API without breaking existing clients. Extensibility: REST Chart is a general-purpose framework that can be used to design REST APIs for a wide variety of distributed resources. Performance: The client-side differential cache mechanism can reduce the overhead of hypertextdriven navigation by up to 66 percentage.[6].

2.2.4 RestAPI Authentication

REST API authentication is the process of verifying the identity of a user or client before granting access to an API. Authentication is typically done by requiring the user to provide some form of credentials, such as a username and password,token. There are a variety of authentication methods that can be used with REST APIs. Some of the most common methods include:Basic authentication,Basic authentication is the simplest form of authentication. It requires the user to provide a username and password in the HTTP request header. API keys, API keys are a more secure form of authentication than basic authentication. They are typically generated by the API provider and assigned to each user or client. API keys are used to identify the user or client in the HTTP request header. OAuth, OAuth is a popular authorization framework that can be used to grant access to REST APIs. OAuth allows users to grant access to an API without having to share their username and password. Mobile applications that use a client-server system need an Application Programming Interface (API) to communicate with each other. Security is important for communication over a network, and encryption methods can be used to provide security. Message Digest 5 (MD5) and Secure Hashing Algorithm 1 (SHA1) are two encryption algorithms that are often used in this case. This study aims to compare the performance of these two algorithms. The Wireshark application was used to retrieve authentication data. The authentication data was then encrypted and tested using the Hashcat tools' brute force attack. The time it took for the REST API Authentication process to complete was also measured for each algorithm using the Postman application. The SHA1 encryption algorithm has the advantage of being stronger, but it takes longer to encrypt data than the MD5 algorithm. However, the difference in encryption time is only 37.1 milliseconds, so SHA1 is still considered a viable option for implementing security systems and REST API authentication in mobile applications. MD5 is faster than SHA1, but SHA1 is more secure. The difference in encryption time between MD5 and SHA1 is only 37.1 milliseconds. SHA1 is still considered a viable option for implementing security systems and REST API authentication in

mobile applications.[7].

2.2.5 Springboot

Spring Boot is a popular Java framework for building web and enterprise applications. It makes it easy to create and deploy stand-alone, production-grade Spring applications with very little Spring configuration. Spring Boot also offers simpler dependency management and a range of additional features that are common across many projects. This paper discusses how the Atmospheric Radiation Measurement (ARM) Data Center (ADC) at Oak Ridge National Laboratory is using Spring Boot to create a SOA-based REST service API. This API bridges the gap between frontend user interfaces and backend databases. Using this API, ARM scientists are now able to submit reports via a user form or a command line interface. This captures the same data quality or other important information about ARM data. The paper begins by providing an overview of Spring Boot and SOA. It then discusses how ARM is using Spring Boot to create a REST service API. The paper concludes by discussing the benefits of using Spring Boot for SOA development. Here are some of the key benefits of using Spring Boot for SOA development: Ease of use: Spring Boot makes it easy to create and deploy SOA applications with very little Spring configuration. Flexibility: Spring Boot is a flexible framework that can be used to create a wide variety of SOA applications. Scalability: Spring Boot is a scalable framework that can be used to create SOA applications that can handle a large number of requests. Security: Spring Boot provides a number of security features that can be used to protect SOA applications from unauthorized access. Overall, Spring Boot is a powerful and versatile framework that can be used to create SOA applications that are easy to use, flexible, scalable, and secure.[8]. The Bureau of Retired Veteran Cadres (BRVC) is a government agency that serves and manages retired veteran cadres. The BRVC faces challenges such as complex management processes and low efficiency in work execution. The application of Internet technology to the BRVC can effectively solve these challenges. This paper proposes to use the SpringBoot framework to develop a customized information system for the BRVC. The system will be based on the microservice architecture and will use Mybits, Redis, and other technologies. The system will effectively solve the problem of the difficulty of refined management of BRVC information. It will also meet the requirements of multi-terminal access, frontend separation, multi-function, low coupling, high cohesion, and easy

scalability. The proposed system will have a number of benefits, including: Increased efficiency: The system will automate many of the BRVC's manual processes, which will free up staff to focus on more strategic tasks. Improved accuracy: The system will reduce the risk of errors by automating data entry and validation. Improved transparency: The system will provide real-time data access to BRVC staff, which will help them to make better decisions. Improved customer service: The system will make it easier for retired veteran cadres to access services and information. The proposed system is a valuable tool that will help the BRVC to improve its efficiency, accuracy, transparency, and customer service. The system will be developed using the SpringBoot framework, which is a popular framework for developing Java-based microservices. The system will use Mybits, a popular NoSQL database, to store data. The system will use Redis, a popular in-memory data store, to cache data. The system will be designed to be scalable, so that it can be easily adapted to meet the changing needs of the BRVC.[9].

2.2.6 Java

Java is a general-purpose, class-based, object-oriented programming language that is designed to have as few implementation dependencies as possible. It is a compiled language and not an interpreted language. Java applications are typically compiled to bytecode that can run on any Java Virtual Machine (JVM) regardless of the underlying computer architecture. The syntax of Java is similar to C and C++, but has fewer low-level facilities than either of them. Java was originally developed by James Gosling at Sun Microsystems. It was released in May 1995 as a core component of Sun Microsystems' Java platform. Java is one of the most popular programming languages in the world. It is used to develop a wide variety of applications, including web applications, mobile applications, desktop applications, and enterprise applications. Optimizing the performance of Java programs is an important task for developers. By minimizing the time and space complexity of a program, developers can improve the performance of their applications. There are a number of techniques that can be used to optimize the performance of Java programs. Some of these techniques include: Using efficient algorithms and data structures Avoiding unnecessary object creation Reducing the number of method calls Using caching Optimizing the garbage collector The proposed model in the paper is a tool that can help developers to optimize the performance of their Java

programs. The tool provides a number of features that can help developers to identify and fix performance bottlenecks. The paper also presents the results of an experiment that was conducted to evaluate the effectiveness of the proposed model. The experiment showed that the model was able to significantly improve the performance of the Java programs that were tested. The proposed model is a valuable tool that can help developers to optimize the performance of their Java programs. The tool is easy to use and can be used to improve the performance of a wide variety of Java programs. The model is a Java application that can be used to analyze Java programs. The model provides a number of features that can help developers to identify and fix performance bottlenecks. The model was evaluated by using it to analyze a number of Java programs. The results of the evaluation showed that the model was able to significantly improve the performance of the Java programs that were tested.[10]. JVM-based processors used in embedded systems are often scaled-back versions of the standard JVM, which means they do not support the full set of Java bytecodes and native methods. As a result, code bases such as Java libraries must be migrated in order to make them suitable for execution on the embedded JVM-based processor. Monarch is a high-assurance Java-to-Java (J2j) source code migrator that is being developed to assist with such code migrations. Monarch is designed to be highly accurate and reliable, and it can be used to migrate code bases of any size. Monarch works by first analyzing the Java code to be migrated. It then generates a new Java source code that is compatible with the embedded JVM-based processor. The new Java source code is then compiled and executed on the embedded system. Monarch has been evaluated on a number of Java code bases, and it has been shown to be highly accurate and reliable. Monarch is a valuable tool for developers who need to migrate Java code to embedded systems. High accuracy: Monarch is designed to be highly accurate, and it can be used to migrate code bases of any size. Reliability: Monarch is designed to be reliable, and it has been evaluated on a number of Java code bases. Ease of use: Monarch is easy to use, and it can be used by developers of all skill levels. Monarch is a valuable tool for developers who need to migrate Java code to embedded systems. Monarch is highly accurate, reliable, and easy to use.[11].

2.2.7 MySQL

MySQL is a relational database management system (RDBMS) that runs as a server. It is a popular choice for web applications, as it is fast, reliable, and scalable. MySQL is also

open source, which means that it is free to use and modify. MySQL was originally developed by Michael Widenius and David Axmark in 1995. It was acquired by Sun Microsystems in 2009, and then by Oracle Corporation in 2010. MySQL is now one of the most popular RDBMSs in the world, with over 6 million active installations. MySQL is a powerful and versatile database. It supports a wide range of data types, including integers, floats, strings, and dates. MySQL also supports a variety of features, such as stored procedures, triggers, and views. MySQL is a reliable database. It has been tested and certified by a number of independent organizations. MySQL is also scalable, and can be used to support a large number of users and transactions. MySQL is an open source database. This means that it is free to use and modify. MySQL is also supported by a large community of developers. MySQL is a popular choice for web applications. It is fast, reliable, scalable, and open source. If you are looking for a database for your web application, MySQL is a good option to consider. The rapid development of data has led to a need for efficient data management solutions. One such solution is the use of databases. The biggest decision in selecting a database is whether to use a SQL or NoSQL database. MySQL is a SQL database that uses tables to store data in the form of columns and rows. NoSQL databases, on the other hand, are designed to handle large amounts of data in a variety of formats. Neo4j is one of the most popular NoSQL databases. It is a graph database that stores data in the form of nodes that are connected by edges. This paper compares the performance of MySQL and Neo4j databases in terms of memory usage, execution time, and flexibility. The results show that MySQL has a faster execution time than Neo4j, although both databases have the same time complexity. Neo4j, on the other hand, has a higher memory usage than MySQL. However, Neo4j has better flexibility than MySQL. The results of this study suggest that MySQL is a better choice for applications that require fast execution time, while Neo4j is a better choice for applications that require flexibility. The study was conducted using a benchmark dataset of 100,000 records. The performance of the two databases was measured in terms of memory usage, execution time, and flexibility. The results of the study showed that MySQL had a faster execution time than Neo4j, but Neo4j had a higher memory usage than MySQL. The study also showed that Neo4j was more flexible than MySQL. The results of this study can be used to help developers choose the right database for their applications.[12]. This paper discusses the importance of data backup and recovery for MySQL databases. The paper takes the China Agricultural University website as an example, and proposes a backup and recovery strategy based on MySQL master-slave replication technology

and logical backup technology. The proposed strategy ensures the high availability and high reliability of the MySQL database by: Real-time synchronization of data between the master and slave database servers. Automatic switching between the master and slave database servers in case of a failure of the master database server. Full recovery of data in case of data misuse. The proposed strategy is a valuable tool for ensuring the normal and efficient operation of information systems and websites based on MySQL databases. Data backup and recovery is essential for MySQL databases. MySQL master-slave replication technology can be used to ensure the high availability of databases. Logical backup technology can be used to ensure the high reliability of databases. The proposed strategy combines MySQL master-slave replication technology and logical backup technology to ensure the high availability and high reliability of MySQL databases. MySQL master-slave replication technology is a technique that allows data to be replicated from one database server (the master) to another database server (the slave). This ensures that there is always a backup copy of the data in case the master database server fails. Logical backup technology is a technique that allows data to be backed up without having to shut down the database server. This is important for ensuring that the database is always available. The proposed strategy combines MySQL master-slave replication technology and logical backup technology to ensure the high availability and high reliability of MySQL databases. The strategy works as follows: The master database server is responsible for storing the main copy of the data. The slave database server is responsible for storing a backup copy of the data. The data is replicated from the master database server to the slave database server in real time. In case the master database server fails, the slave database server can be automatically switched to become the new master database server. The logical backup technology is used to back up the data on the master database server on a regular basis. In case of data misuse, the logical backup technology can be used to restore the data from the backup. The proposed strategy is a valuable tool for ensuring the normal and efficient operation of information systems and websites based on MySQL databases. It helps to protect the data from loss or damage, and it ensures that the database is always available.[13].

2.2.8 Difference between MySQL and MongoDB

MySQL and MongoDB are two of the most popular database management systems (DBMSs) in the world. They are both open source and have a large community of users and developers.

However, there are some key differences between the two systems. MySQL is a relational database management system (RDBMS). RDBMSs store data in tables, which are made up of rows and columns. Each row represents a single record, and each column represents a single piece of data about that record. MySQL is a very popular RDBMS, and it is used by a wide range of organizations, including small businesses, large enterprises, and government agencies. MongoDB is a document-oriented database management system (NoSQL). NoSQL databases store data in documents, which are similar to JSON objects. Documents can contain any type of data, and they can be nested within each other. MongoDB is a popular choice for storing large amounts of unstructured data, such as social media data, log files, and sensor data. The world has evolved to a point of advancement where technology, industry standards, gadgets, and devices produce enormous amounts of data. This data requires an essential data management and manipulation system. The data acquired from various input and output sources that are used to provide a certain infrastructure are also susceptible to damage if not treated well, which may result in data loss. To overcome this loss, various strategies are being used to prevent such loss. One such example is the NoSQL database MongoDB. MongoDB is a cross-platform, document-oriented database that provides high performance and easy scalability, ensuring effective data management with its prominent feature of auto sharding. Sharding splits the database across multiple servers, increasing the capacity and scalability as required. This feature handles the distribution of data in different nodes to maximize disk space and dynamically load balance queries. Partitioning the databases appropriately is a major step that determines the efficiency of sharding. This involves choosing an index of the MongoDB, competently as a shared key for further horizontal scaling of the database. Our current research involves the study of this load balancer. This paper intends to ascertain the need for NoSQL databases in the present situation and emphasize the advancement of document-oriented database - MongoDB in particular by describing with a quantitative example that SQL databases are prone to deterioration when data is overloaded and MongoDB comes with an inbuilt load balancer which makes it a better solution in applications with high data load. We describe the technology of sharding - auto load balancing feature of MongoDB and hope to provide a comprehensive insight of the process. NoSQL databases are becoming increasingly popular as they offer a number of advantages over traditional SQL databases, such as scalability, flexibility, and performance. MongoDB is a leading NoSQL database that is known for its high performance, scalability, and flexibility. MongoDB's auto sharding feature allows it to scale

horizontally, which means that it can add more servers as needed to handle increased load. MongoDB's auto load balancing feature ensures that queries are distributed evenly across all shards, which helps to improve performance. The paper concludes by discussing the benefits of using MongoDB for applications with high data load.[14].

2.2.9 React

React is a JavaScript library for building user interfaces. It is used by a wide range of companies, including Facebook, Instagram, and Netflix. React is known for its speed, flexibility, and scalability. React is based on the concept of components. A component is a small, reusable piece of code that can be used to build a user interface. Components are declarative, which means that they describe what the user interface should look like, not how it should be rendered. This makes React code easy to read and understand. React is also highly performant. It uses a virtual DOM, which means that it only updates the DOM when necessary. This can lead to significant performance improvements, especially on large and complex user interfaces. React is a powerful tool for building user interfaces. It is fast, flexible, and scalable. If you are looking for a JavaScript library for building user interfaces, React is a good option to consider. Declarative, React components describe what the user interface should look like, not how it should be rendered. This makes React code easy to read and understand. Virtual DOM, React uses a virtual DOM, which means that it only updates the DOM when necessary. This can lead to significant performance improvements, especially on large and complex user interfaces. Reusable components, React components are small, reusable pieces of code that can be used to build a user interface. This makes it easy to create consistent and maintainable user interfaces. Large community, React has a large and active community of developers. This means that there are many resources available to help you learn React and build user interfaces. The world has become increasingly data-driven, and the amount of data being generated is growing exponentially. This data needs to be managed and manipulated effectively in order to be useful. Traditional database management systems (DBMSs) are not well-suited for managing large amounts of unstructured data. NoSQL databases, such as MongoDB, are a better choice for managing this type of data. MongoDB is a cross-platform, document-oriented database that provides high performance and easy scalability. It is a good choice for storing large amounts of unstructured data, such as social media data, log files, and

sensor data. The Networked Control System Laboratory (NCSLab) is a remote laboratory that was created in 2006 in the UK. It is a good solution to the problems of limited experimental environment and shortage of laboratory equipment. However, some of the technologies used in NCSLab are not up-to-date and some of them have even lost support. In order to improve the long-term development of NCSLab, it is necessary to update the technologies used. This paper proposes a solution to update the NCSLab system by using the React user interface framework. React is a modern JavaScript library that is used to create user interfaces. It is a good choice for creating dynamic and interactive user interfaces. The proposed solution has been implemented in NCSLab and it has been shown to be effective. The response speed of the web pages has been significantly improved and the scalability, interactivity, and user-friendliness of the system have been enhanced. The proposed solution is a valuable contribution to the field of remote laboratories. It provides a way to update and improve existing remote laboratories using modern technologies. This will make remote laboratories more accessible and useful to a wider range of users. MongoDB is a good choice for storing large amounts of unstructured data. React is a modern JavaScript library that is used to create dynamic and interactive user interfaces. The proposed solution has been implemented in NCSLab and it has been shown to be effective. The proposed solution is a valuable contribution to the field of remote laboratories.[15].

Chapter 3

Methodology

BAYER BUY - Ecommerce Website provides user with a user-friendly catalog containing comprehensive and relevant information about the products. It includes detailed product descriptions, characteristics, and instructions on how to use the products effectively on crops. The catalog highlights the versatility of the products, showcasing their suitability for use with a wide range of crops.

In the new system, the user interface (UI) is exposed to the outer environment, providing a seamless and user-friendly experience for customers. The system offers a user registration process that allows individuals to create an account by providing their name, email address, password, and address. Once registered, users can access the system's login page. On the login page, users can enter their registered email address and password to authenticate and gain access to the system. Upon successful login, users are issued a secure authentication token, such as a JWT (JSON Web Token), which is utilized for subsequent interactions with the system.

With the authenticated token, users are directed to the dynamic and visually appealing Product Catalogue page. This page prominently displays the company's various categories and showcases top-rated products. The UI design focuses on simplicity, intuitiveness, and easy navigation, ensuring that users can effortlessly explore the available products.

The Product Catalogue page provides rich product information, including detailed descriptions, specifications, pricing, and customer reviews. Users can interact with the UI elements to filter and sort products based on their preferences. The system incorporates advanced search functionality, enabling users to find specific products quickly.

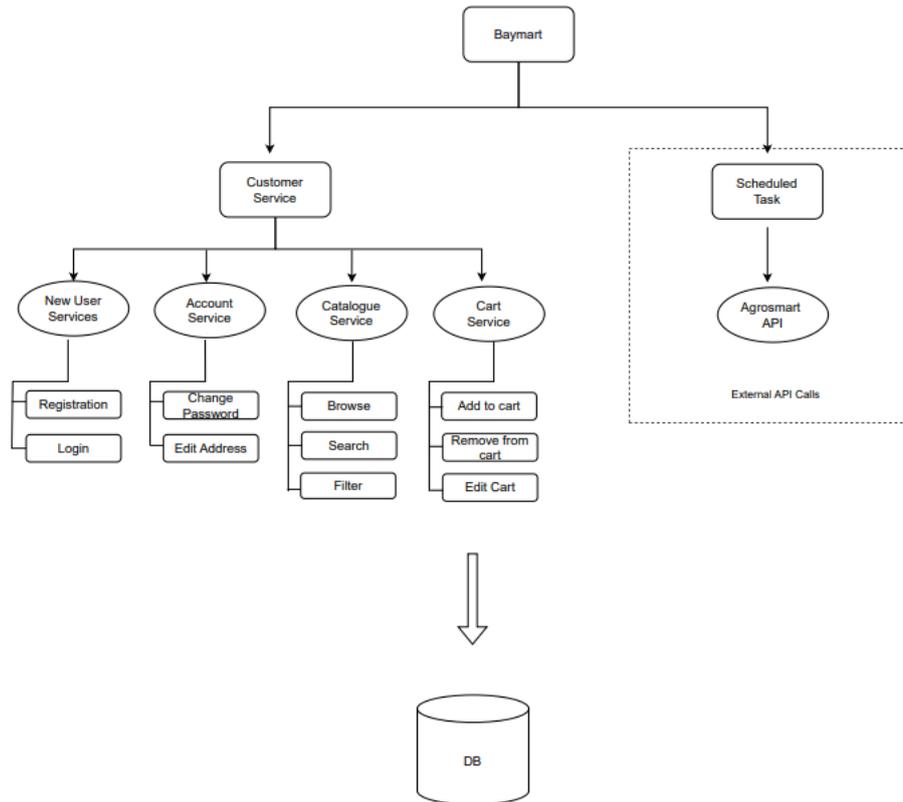


Figure 3.1: HLD diagram of the system

3.1 Key Features of Bayer Zone

- Login Functionality.
- Registration Functionality.
- Home Page:
 1. Top Rated Product.
 2. Category Wise.
 3. Product Page.
- Change Password functionality.
- Change Personal Information.

3.2 Module Description

3.2.1 User Management Module

User management includes features such as user registration, authentication, and user profiles. During the registration process, users can create accounts by providing their personal information. The authentication system handles user login, session management, and password reset functionality, ensuring secure access to the platform. User profiles allow individuals to manage their personal details, including addresses, providing a personalized experience. These user management features contribute to a seamless and tailored e-commerce experience for Bayer Buy customers.

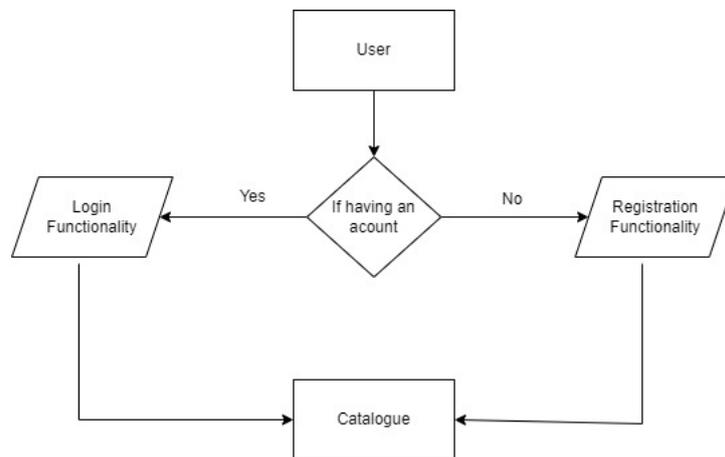


Figure 3.1: User Interaction in Login and Registration

Google login is provided using the client id generated and validated in the backend using the token generated after the login. Each user in the system will have a unique user id generated which is then used for identifying the user. Forgot password functionality allows the user to easily recover their accounts. An email will be generated with an encrypted token that will be used for the recovery purpose. After successful login, the user will be redirected to the IoT Manager home page. User login authentication is done through cookies and Redis db data. When a user logs in to the system login information will be stored as a cookie and redis data in the server. Only logged users can access the portal. After 48 hours of inactivity, the users will be automatically logged out of the portal.

3.2.2 Product Management Module

At the heart of the Bayer Buy e-commerce platform lies its product management module. It is designed to provide users with a seamless and informative experience when exploring and considering different products. One of the key components of this system is the comprehensive product catalog, which includes a wide range of offerings across various categories. The catalog allows users to browse through the available products and discover items that align with their specific needs and preferences.

To enhance the user experience, the product management module incorporates powerful search and filtering capabilities. Users can easily search for products based on their desired criteria, such as product name, category, or specific features. This functionality enables users to quickly narrow down their options and find the products that best suit their requirements.

When users access a specific product page, they are presented with detailed information about the product. This information includes the product name, average rating, total likes and dislikes, category, country, and additional details about the specific crop protection product. The product page also showcases the product image, allowing users to visualize the item they are interested in. This visual representation adds clarity and assists users in making informed decisions. These details provide users with a comprehensive understanding of the product, its benefits, and its recommended use cases.

By presenting this comprehensive product information, the product management module empowers users to make informed decisions. Users can assess the product's suitability for their specific needs, understand its benefits and recommended use, and evaluate its ratings and feedback from other customers. This transparency and depth of information contribute to a positive and satisfactory shopping experience, where users feel confident in their product choices.

3.2.3 Scheduler

The Bayer Buy e-commerce platform incorporates a scheduler module that integrates with the external AgroSmart API. This module enables the automated retrieval of product details from the AgroSmart API and synchronizes them with the platform's product management system.

By establishing this connection, the scheduler module ensures that the product catalog remains up to date with the latest information and availability from the AgroSmart platform.

The scheduler module utilizes scheduled tasks or cron jobs to periodically fetch product data from the AgroSmart API. This data may include information such as product names, descriptions, ratings, and any other relevant details. Upon retrieving the data, the scheduler module processes it and updates the product catalog within the Bayer Buy e-commerce platform accordingly.

By integrating with the AgroSmart API, the scheduler module enhances the platform's efficiency and accuracy in presenting the most current and accurate product information to users. It reduces the manual effort required to maintain product data by automating the data synchronization process. This integration ensures that users have access to the latest product details, enabling them to make informed purchasing decisions based on real-time information from the AgroSmart platform.

3.3 System Specifications

The software and hardware specifications recognized for the system on the basis of their requirements are specified in this section.

3.3.1 Hardware Requirements

- Processor: Minimum 1 GHz (Recommended 2GHz or more)
- Hard Drive: Minimum 4 MB (Recommended 6 GB or more)
- Memory (RAM): Minimum 1 GB (Recommended 4 GB or above)
- Internet connection

3.3.2 Software Requirements

- React - Front End

- Spring Boot - Back End
- Web Server - Tomcat
- MySQL - Database
- Windows, Mac, Linux, Any - OS
- Mozilla Firefox, Microsoft Edge, Any - Browser

3.3.3 Software Description

- **React:** React is a popular JavaScript library used for building user interfaces for web applications. It was developed by Facebook and is widely adopted in the industry. React follows a component-based architecture, where the UI is divided into reusable components. Each component encapsulates its own logic and rendering, making it easier to build complex UIs. React supports a declarative programming style. Developers can describe how the UI should look based on the current state, and React takes care of updating the actual DOM to match that description. This simplifies the development process and improves code maintainability. React utilizes a virtual DOM (Document Object Model) to efficiently update and render components. When there are changes in the component's state or props, React updates the virtual DOM and efficiently determines the minimal number of actual DOM manipulations needed to reflect those changes. React can be used with other libraries and frameworks, allowing developers to integrate React into existing projects easily. It is commonly used in conjunction with tools like Redux for state management and React Router for handling routing in single-page applications.
- **Spring Boot:** Spring Boot is a Java-based framework that simplifies the development of standalone, production-ready applications. It is built on top of the popular Spring framework and provides a streamlined approach to building Java applications with minimal configuration. Spring Boot aims to accelerate application development by providing a convention-over-configuration approach. It eliminates the need for boilerplate code and XML configurations, allowing developers to focus more on business logic and less on infrastructure setup. Spring Boot comes with sensible default configurations for various

components and frameworks, reducing the need for manual setup. It automatically configures many aspects of the application, such as database connections, web servers, and security, based on sensible conventions and best practices. Spring Boot includes an embedded servlet container (e.g., Tomcat, Jetty) that allows you to run your application as a standalone executable JAR file. This feature simplifies deployment and makes it easy to build self-contained, portable applications. Spring Boot provides automatic configuration based on classpath dependencies. It detects the presence of specific libraries and automatically configures them, saving developers from writing boilerplate code. Additionally, custom configurations can be easily overridden or extended as needed. Spring Boot integrates with the powerful Maven or Gradle build systems and provides dependency management capabilities. It resolves and manages dependencies, ensuring compatibility and simplifying version management.

- **MySQL:** MySQL is an open-source relational database management system (RDBMS) that is widely used for storing and managing structured data. It is one of the most popular databases in the world and is known for its performance, scalability, and ease of use. It organizes data into tables with rows and columns. It supports the SQL (Structured Query Language) standard for interacting with the database and performing operations such as querying, inserting, updating, and deleting data. MySQL is an open-source database, which means it is freely available and can be used, modified, and distributed by anyone. This makes it accessible to a wide range of developers and organizations and has contributed to its popularity. Follows a client-server architecture, where the database server handles the storage and management of data, and clients (applications or tools) interact with the server to access and manipulate the data. Clients can communicate with the server using various protocols, such as TCP/IP or named pipes. It is optimized for handling large datasets and can efficiently handle concurrent read and write operations. It includes features like caching, indexing, and query optimization techniques to improve performance. Ensures data integrity by enforcing referential integrity constraints and providing support for transactions. It follows the ACID (Atomicity, Consistency, Isolation, Durability) properties, which guarantee that database transactions are processed reliably and consistently.
- **REST Api:** A RESTful API (Representational State Transfer API) is an architectural

style and set of guidelines for building web services that allow different systems to communicate with each other over the internet. RESTful APIs are widely used for creating scalable and interoperable applications. RESTful APIs are centered around resources, which can be any entity or concept that needs to be represented and manipulated. Resources are identified by unique URLs (Uniform Resource Locators), also known as endpoints. RESTful APIs follow a stateless communication protocol, meaning that each request from a client to a server is independent and self-contained. The server doesn't maintain any client state between requests, and each request must include all the necessary information for the server to understand and process it. RESTful APIs provide a set of standard operations, often referred to as CRUD (Create, Read, Update, Delete), to perform actions on resources. These operations map to the standard HTTP methods: POST (create), GET (read), PUT/PATCH (update), and DELETE (delete).

3.4 System Design

The system design phase effectively bridges the gap between the issue area and the current system, addressing the solution area - specifically, "how to implement?" During this stage, the SRS documentation is converted into an effective implementation format that also outlines the system's operation. The complex task of system development is broken down into manageable sub-activities that work together to achieve the ultimate goal of system development. A good design enables the production of efficient code and minimizes implementation size based on the application and project requirements.

System design comprises two levels: logical design and physical design. Logical design provides an abstract illustration of the system's inputs, outputs, and data flow, meeting user needs in describing inputs (sources), outputs (destinations), databases (data storage), and processes (data flows). Logical design is crucial for the successful implementation of a corporate database. An inadequate logical design may require costly modifications to data collection, storage, and security later on. A sound preliminary design simplifies database development and evaluation, contributing to successful execution. The system analyst specifies user requirements in detail, essentially dictating the information flow into and out of the system and the necessary data sources during logical system design.

When developing a system's logical design, the system analyst specifies user needs with enough detail to determine how information enters and leaves the system and the required data sources. Diagrams of data flow and E-R diagram modeling are used. Additionally, the input/output media is specified, the database is designed, and backup procedures are established. Finally, system implementation is planned.

3.4.1 System Architecture

Users interact with the e-commerce website through a web browser on the client-side, where they can view and interact with various products. The client-side communicates with the server-side by sending HTTP requests and receiving responses. Acting as an intermediary, the web server receives incoming requests from the client-side and forwards them to the server-side application for processing. Additionally, the web server serves static files, such as HTML, CSS, and JavaScript files, to the client-side to display the user interface and enable interactive functionalities.

In the backend, the server-side application is built using Spring Boot, a Java framework that simplifies the development of robust and production-ready Spring-based applications. Spring Boot handles request routing, data processing, and the execution of business logic. It provides a structured and efficient way to handle incoming requests, ensuring that the application responds promptly to user actions.

To store the product data, a MySQL database is utilized. The database stores essential information about the products, including their names, descriptions, prices, and availability. The server-side application interacts with the database to retrieve and update product information as needed. The use of a database ensures data persistence and enables efficient querying and retrieval of product information. The server-side application exposes a set of RESTful APIs that the client-side can utilize to access product information. These APIs define endpoints that correspond to specific functionalities, such as retrieving a list of products, adding items to the shopping cart, or placing an order. The server-side application processes the incoming API requests, executes the necessary business logic, and sends back responses to the client-side in a standardized format, typically JSON.

By employing this system architecture, the Spring Boot e-commerce application with

React as the frontend provides a scalable, efficient, and secure solution for handling user interactions, retrieving and processing product information, and ensuring a smooth user experience. The separation of concerns between the client-side and server-side allows for independent development and easier maintenance of the application components.

3.4.2 Module Design

The Bayer Buy e-commerce platform is designed with a robust system architecture that ensures a seamless shopping experience. Users interact with the platform through web browsers or mobile applications, enjoying a visually appealing and responsive user interface. To enhance the user experience, the platform employs responsive design principles, ensuring that it adapts seamlessly to various devices and screen sizes. This mobile-friendly approach enables users to browse and make purchases conveniently from their smartphones or tablets, offering flexibility and accessibility. The application layer handles the core business logic, including catalog management and inventory control. In addition to catalog management and inventory control, the application layer of the Bayer Buy e-commerce platform also encompasses user management functionalities, which play a vital role in ensuring a personalized and secure experience for users. User management functionalities within the application layer enable the registration, authentication, and authorization of users. The platform allows users to create accounts, providing them with unique credentials and profiles that store their personal information. Integration with external services such as the Agrosmart Api of Bayer is facilitated through the integration layer. The integration layer of the Bayer Buy e-commerce platform plays a crucial role in connecting and interacting with external services, such as the Agrosmart API provided by Bayer. This integration enables the platform to leverage the rich data and capabilities offered by these external services, enhancing the overall functionality and value provided to users. Through the integration layer, the platform can securely communicate with the Agrosmart API, which provides real-time data and insights related to crop Protection Products and the Seed Products. This integration empowers users to make more informed decisions when selecting farming aid products, aligning their choices with the specific needs of their crops and local agricultural conditions. By accessing and utilizing this external data, the platform enhances its ability to deliver personalized and relevant recommendations to users.

Data storage is a critical aspect of the Bayer Buy e-commerce platform, and it is handled

by a reliable and secure database system. The platform ensures that user data, including personal information, order details, and preferences, is stored securely to protect user privacy and maintain data integrity. The database system is designed to handle high volumes of data and support efficient data retrieval and processing, contributing to a seamless user experience.

To further ensure the security of user data, the platform incorporates robust security measures within its architecture. Authentication mechanisms verify the identity of users, ensuring that only authorized individuals can access their accounts and perform actions within the platform. Encryption techniques are employed to protect sensitive information, such as passwords and payment details, during transmission and storage. By adhering to industry-standard security protocols and best practices, the platform establishes a secure environment for user data, mitigating the risks of unauthorized access and data breaches.

In addition, the Bayer Buy e-commerce platform complies with relevant industry standards and regulations pertaining to data security and privacy. By adhering to these standards, the platform demonstrates its commitment to protecting user data and maintaining the trust of its users. Overall, the integration layer facilitates seamless communication with external services, enabling the platform to leverage valuable data and insights. The secure storage of data and the implementation of security measures within the platform's architecture contribute to the protection of user data and privacy. By ensuring the integrity and security of user data, the Bayer Buy e-commerce platform creates a trustworthy and reliable environment for users to engage in their farming aid product purchases.

- **User Management Module:** User management includes features such as user registration, authentication, and user profiles.
- **Product Management Module:** This system encompasses key components such as the comprehensive product catalog, search and filtering capabilities, and detailed product information pages.
- **Scheduler Module:** The scheduler module in the Bayer Buy e-commerce platform automates the retrieval and synchronization of product details from the AgroSmart API, ensuring users have access to up-to-date information.

Chapter 4

Result And Discussion

React, Spring Boot, and MySQL were effectively used in the creation and implementation of the **BAYER BUY - Ecommerce Website**. The platform aims to give consumers a smooth experience when exploring products. The following outcomes were obtained:

- **User authentication:** Users were able to log in using both Google login and regular login thanks to the authentication module. It offered a convenient and safe identification process.
- **Product Listing:** The product list module swiftly collected and showed a detailed list of the items that were available. The frontend interface rendered the product cards with the necessary details, such as the name, image, and rating.
- **Product Details:** The product detail module offered comprehensive details on specific goods. Product details, features, reviews, and similar goods were all successfully obtained and presented.
- **Search functionality:** Using several criteria, like name, category, or keywords, the search module allowed users to look for specific goods. It efficiently processed users' search requests and returned pertinent search results.
- **Sorting and Filtering:** The filter and sorting module let customers customise their experience while looking through products. Users may sort goods by popularity, or rating and add filters based on rating. The module successfully used these filters and gave users ordered product listings.

4.1 Testing Methods

Testing ensures that the system is error-free based on criteria that are anticipated by the user or by the organization. A system may have high-end or low-end performance based on the environment in which it operates. Testing is a critical part of the software development process. It helps to ensure that the software is free of errors and that it meets the requirements of the users. There are many different types of testing, each with its own purpose. Some common types of testing include unit testing, integration testing, system testing, and acceptance testing.

Unit testing is the lowest level of testing. It is used to test individual units of code, such as functions or classes. Integration testing is used to test how different units of code interact with each other. System testing is used to test the entire system as a whole. Acceptance testing is used to test the system with the users to make sure that it meets their requirements.

The environment in which a system operates can have a significant impact on its performance. For example, a system that is designed to run on a high-end server will likely perform better than a system that is designed to run on a low-end laptop. It is important to consider the environment in which a system will operate when designing and testing the system.

By testing the system thoroughly, you can help to ensure that it is error-free and that it performs well in the environment in which it will operate. This will help to improve the user experience and make the system more reliable.

4.1.1 Functionality Testing

These tests check if the part of the system that is supposed to do something actually works well or not. The QA team makes some tests based on what needs to be checked, and then they test them out. QA team tests the functionalities according to the requirements of the product.

- **Login Functionality:** This test verifies that users can log in using the login page and also register as a new user in the system. To test the login functionality, various scenarios can be simulated, such as incorrect login credentials, expired passwords. By conducting comprehensive testing of the login functionality, the platform can ensure a seamless user

experience and prevent potential security breaches.

- **Data Security:** This test verifies that only authorized users have access to the platform and that user data is secured. It also tests that the system prevents unauthorized access attempts and that user data is encrypted during storage. This can include verifying that the platform enforces strong password requirements, such as minimum length and complexity, to protect user accounts from brute force attacks or password guessing. Testing should also ensure that passwords are securely stored using appropriate encryption techniques, to safeguard them from unauthorized retrieval. In addition, the testing should verify the implementation and functioning of JWT (JSON Web Tokens) for authentication and authorization. This includes testing the generation, validation, and expiration of tokens to ensure that only authenticated users can access protected resources and perform authorized actions.
- **Error Handling:** This test verifies that the system provides appropriate error messages for various scenarios, such as incorrect login credentials or attempting to access restricted features. Furthermore, the error handling testing should also include verifying that the system logs errors for debugging purposes. This helps the development team identify and resolve issues more efficiently by providing detailed information about the occurrence of errors. Proper error logging enables the team to analyze and investigate the root causes of errors, facilitating the improvement of system stability and performance. By conducting comprehensive error handling testing, the Bayer Buy e-commerce platform can enhance the user experience by providing clear and actionable error messages. This helps users understand the nature of the errors they encounter and guides them towards appropriate actions. Additionally, effective error logging enables the development team to monitor and address issues promptly, leading to a more robust and reliable system.
- **Product Retrieval:** Testing the product retrieval API endpoints involves validating that the endpoints are functioning correctly and returning the expected data. During testing, various scenarios can be simulated to cover different aspects of product retrieval. This can include verifying that the API endpoints return accurate search results based on different search criteria, such as product names, categories, or specific attributes. In addition to successful product retrieval, it is important to test error handling within the API endpoints. This includes verifying that the endpoints return appropriate error responses

when invalid or malformed requests are made, such as missing parameters or invalid search queries. Error handling testing also ensures that the platform provides informative and user-friendly error messages, assisting users in troubleshooting and resolving issues effectively.

4.1.2 Unit Testing

In this project, unit testing is an important aspect of validation testing, aimed at identifying defects in individual sections of the project. Unit testing is used to evaluate the functionality and performance of each system unit or component in isolation. This testing helps developers to identify and resolve issues early on, thereby minimizing the risk of encountering problems during deployment or integration. A successful validation test confirms that the system meets the requirements, while a failed test indicates that modifications are necessary. Unit testing is a critical step in the validation process, enabling developers to ensure that the system performs as expected and meets the needs of all stakeholders.

The portal is tested against multiple test cases during validation testing. Logging in to the system is one of the important part of the system. The registration process in the Bayer Buy e-commerce platform begins with users providing their personal information, including their name, email address, and password. This information is then validated to ensure its accuracy and compliance with any predefined rules or constraints. Once the validation is successful, the registration process continues. During registration, the system checks for existing users with the same email or phone number to prevent duplicates and maintain data integrity. If no duplicates are found, the password provided by the user is further validated for complexity, ensuring it meets the required criteria for a secure password.

4.1.3 User Acceptance Testing

The success of any system depends largely on user acceptance. To ensure this, the system must undergo continuous evaluation and testing throughout the development phase. This entails maintaining open communication with potential end-users and incorporating their feedback into the system's design. In this project, a menu-driven system, input screen design, and output screen design were carefully considered and implemented to achieve user approval. User-

centered design is the process of involving users in the design and development of the system, ensuring that their needs and preferences are met. This leads to higher levels of user satisfaction and system adoption.

User Acceptance Testing (UAT) is a critical phase in the development of any software application, including the Bayer Buy e-commerce platform. UAT involves testing the system's functionality, usability, and performance to ensure it meets the requirements and expectations of end users. Here are some of the User Acceptance Tests that were performed on the Bayer Buy e-commerce platform: Test Scenarios:

- **Registration Process:** Test the registration process by creating a new user account with valid information. Verify that the user is successfully registered and can log in to the platform.
- **Product Search and Filtering:** Perform a search for a specific product using different search criteria. Verify that the search results are accurate and relevant to the search query. Test the filtering options (such as price range, category, etc.) and ensure they effectively narrow down the product selection.
- **User Profile Management:** Test the functionality to edit and update user profile information. Verify that changes to the profile, such as address or contact details, are saved correctly. Test the password change feature and ensure it functions as expected.
- **Error Handling and Exception Scenarios:** Test various error scenarios, such as entering invalid user information during registration. Verify that appropriate error messages are displayed, guiding the user to correct any input errors.
- **Log out of the system and verify that my session is ended and I am unable to access the platform without valid credentials.**

4.1.4 Sample Test Cases

To assess the functionality and performance of the system, a set of sample test cases was conducted. These test cases aimed to validate various aspects of the system's features and ensure its reliability, accuracy, and usability. The following is an introduction to the sample test cases used in the project report.

1. Login and Authentication: Verify that valid user credentials allow successful login. Confirm that incorrect or invalid credentials result in appropriate error messages. Test the "Remember Me" functionality to ensure persistent login across sessions. Validate the system's response to unauthorized access attempts.

2. Product Catalog:

Check that all products are accurately displayed with relevant information such as name, description, price, and availability. Test the search functionality to ensure accurate results based on keywords, categories, or filters.

Test Case ID	Test Case Description	Test Steps	Expected Results	Actual Results	Status (Pass/Fail)
1	CreateUser_Success	1. Provide valid user input data 2. Call the createUser in the UserService 3. Verify the response status code is 201 (CREATED) 4. Verify the response body has the correct data and message	User is created successfully	User is created successfully	Pass
2	CreateUser_UserAlreadyExistsException	1. Provide user input data that conflicts with existing user 2. Mock the createUser method to throw the exception 3. Call the createUser method in the UserController 4. Verify the exception type and error message	UserAlreadyExistsException is thrown	UserAlreadyExistsException is thrown	Pass
3	CreateUser_ConstraintViolationException	1. Provide invalid user input data that violates constraints 2. Mock the createUser method to throw the exception 3. Call the createUser method in the UserController 4. Verify the exception type and error message	ConstraintViolationException is thrown	ConstraintViolationException is thrown	Pass

Figure 4.1: Sample Test sheet for the Registration Functionality

4.2 Output Screens and Results

1. User Home Page The home to page where the user arrives upon successful login. Here the different categories and the highly rated products are shown to the user.

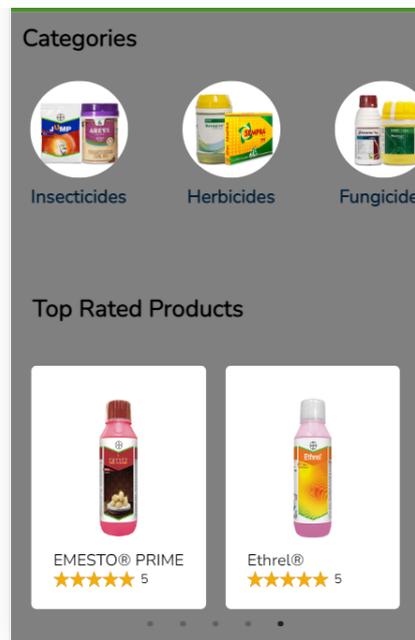


Figure 4.2: User Home Page

2. Product Details Page

The Product Details Page on the Bayer Buy platform provides users with comprehensive information about each product. It includes key features like ratings, available sizes, and options to like or dislike the product. Ratings allow users to provide feedback and help others make informed decisions. Available sizes help users select the right variant for their needs, especially for farming aid products. The page also displays product descriptions, specifications, pricing, and customer reviews, enabling thorough evaluation before purchase.

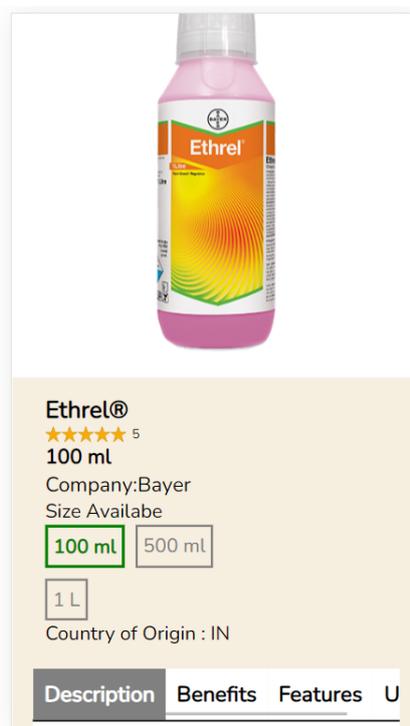


Figure 4.2: Information on single product

3. View Details Page

As users scroll down the Product Details Page on the Bayer Buy e-commerce platform, they will find additional information about the product. This includes a detailed description, highlighting the purpose and characteristics of the product. Users will also discover the benefits associated with the product, showcasing the positive outcomes it can provide for their farming practices. Furthermore, the features of the product are outlined, emphasizing its unique attributes and functionalities. Additionally, users will find guidance on the product's usage and application, ensuring they can utilize it

effectively. This comprehensive presentation of information allows users to make well-informed decisions about the product and its suitability for their specific needs.

Description	Benefits	Features	Usage
<p>It is a selective herbicide. Acts as post-emergence hence gives flexibility of application. Gives excellent control over difficult to control weeds like Monochoria and Scirpus. Effectively controls annual sedges like Cyperus rotundus. Acts at a very low dose being sulfonyl urea.</p>			

Figure 4.3: Continuation of the description of the product

Chapter 5

Conclusion

The **BAYER BUY - Ecommerce Website** platform stands as a game-changer in the agriculture industry, revolutionizing the way farmers, growers, and customers interact with agricultural products and services. Through its user-friendly interface, comprehensive product catalog, personalized user management features, and integration with the AgroSmart API, Bayer Buy empowers users with a seamless and efficient online shopping experience.

One of the core strengths of Bayer Buy lies in its product management module, which serves as the backbone of the platform. This module provides users with a vast array of products, enhanced search and filtering capabilities, and detailed product information pages. By enabling easy product discovery, offering essential details, and facilitating informed decision-making, the product management system enhances customer engagement and satisfaction. The user management features of Bayer Buy further contribute to its success. With user registration, authentication, and user profiles, the platform ensures secure access and allows users to manage their personal information and addresses. This personalized experience fosters trust, convenience, and a sense of belonging, building long-term relationships with customers.

The integration of the AgroSmart API through the scheduler module adds another layer of value to Bayer Buy. By automating the retrieval and synchronization of product details, the platform remains up to date with the latest information and availability. This integration enhances efficiency, accuracy, and the ability to provide real-time information to users, enabling them to make informed purchasing decisions based on the most current data.

Furthermore, the adoption of modern technologies such as Spring Boot for the server-side application and React for the client-side interface ensures a robust and user-friendly platform. The architecture leverages the capabilities of these frameworks to handle request routing, data processing, and the execution of business logic seamlessly. The MySQL database stores product data, enabling efficient retrieval and management of essential information.

Bayer Buy's commitment to user satisfaction, innovation, and industry transformation sets it apart from traditional agricultural supply models. By embracing digital technologies, connecting directly with customers, and reducing reliance on intermediaries, the platform empowers both companies and customers. Companies gain greater control over their online presence, reduced costs, and improved customer experiences, while customers benefit from personalized interactions, convenient access to a wide range of products

5.1 Future Enhancement

While Bayer Buy has already made significant strides in transforming the agriculture industry, there are several potential future enhancements that can further enhance the platform's capabilities and user experience. These enhancements encompass various aspects of the platform, ranging from expanding product categories to integrating cutting-edge technologies. By incorporating these future enhancements, Bayer Buy can continue to lead the way in digital agriculture and provide farmers and growers with advanced tools and resources. One potential future enhancement is the expansion of product categories. While Bayer Buy already offers a comprehensive range of products, there is room for growth by including additional categories such as fertilizers, machinery, tools, and accessories. This expansion would enable users to fulfill all their agricultural needs in one centralized platform, making Bayer Buy a true one-stop-shop for farmers and growers.

Integrating Bayer Buy with precision farming technologies is another exciting avenue for future enhancement. By connecting the platform with real-time data on soil conditions, weather patterns, and crop health, farmers can make informed decisions and optimize their farming practices. This integration can provide personalized recommendations, enabling farmers to achieve higher crop yields, reduce resource wastage, and promote sustainable agriculture.

The rise of IoT devices presents an opportunity for Bayer Buy to integrate with these technologies. By connecting with sensors, drones, and other IoT devices, the platform can collect and analyze data to deliver valuable insights to users. These insights can range from pest management recommendations to irrigation scheduling, empowering farmers with actionable information for effective farm management.

Enhancing customer engagement is another crucial area for future enhancement. Introducing interactive features such as user reviews, ratings, and recommendations can foster a sense of community and encourage user participation. Moreover, personalized product suggestions based on user preferences and purchase history can create a tailored shopping experience, strengthening customer loyalty and satisfaction.

In the future, the system can also be incorporated with more advanced analytics capabilities to gain deeper insights into customer behaviour.

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Appendix

Screenshots

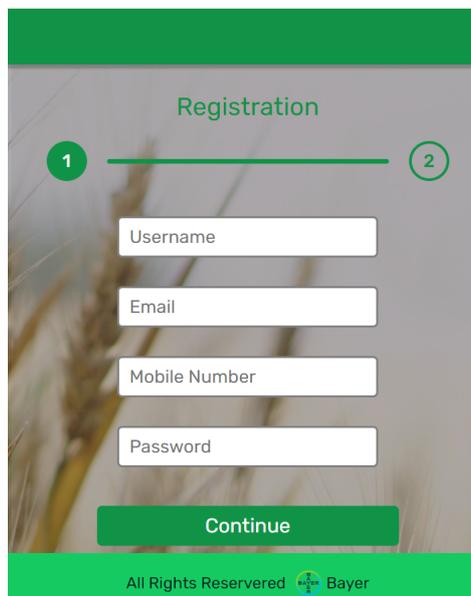


Figure 5.1: Registration Page

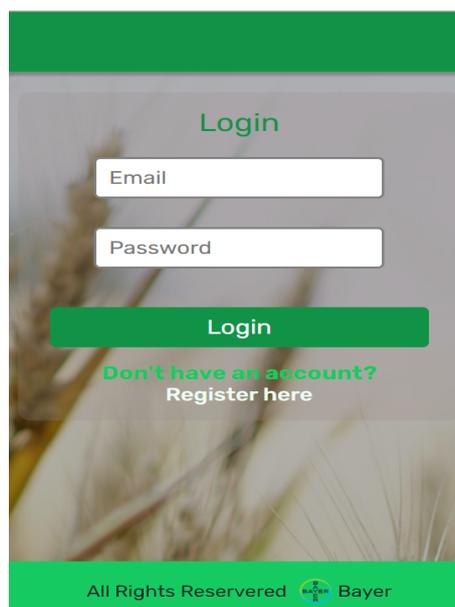


Figure 5.2: Login Page

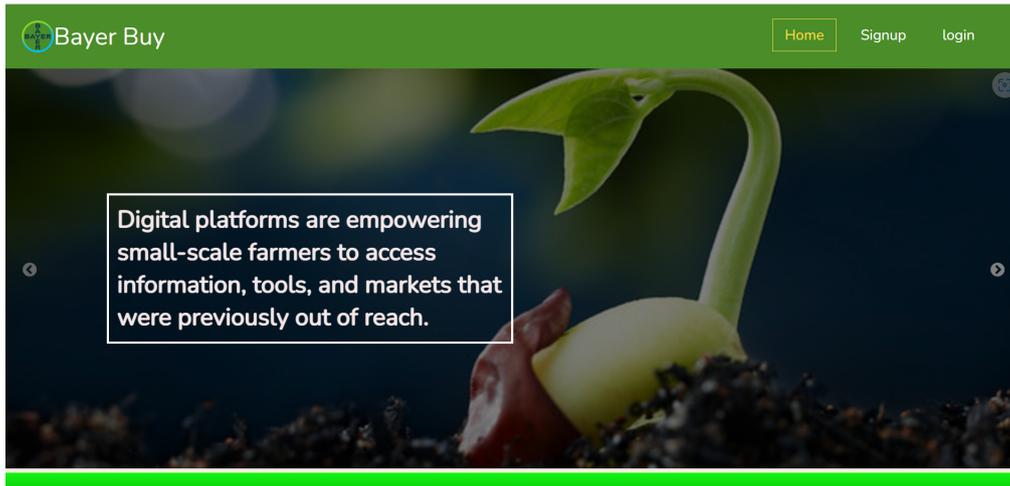


Figure 5.3: Home Page of the Application

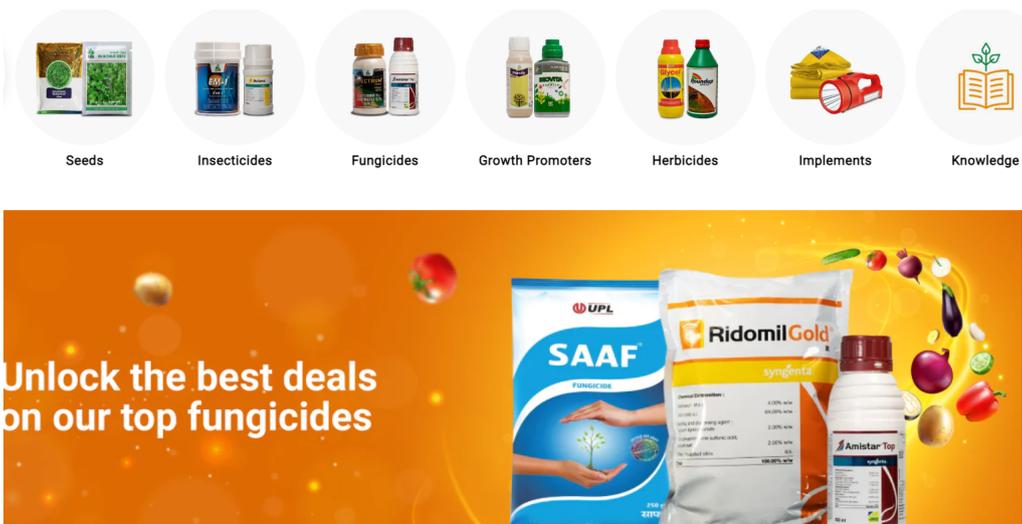


Figure 5.4: Users Home Page

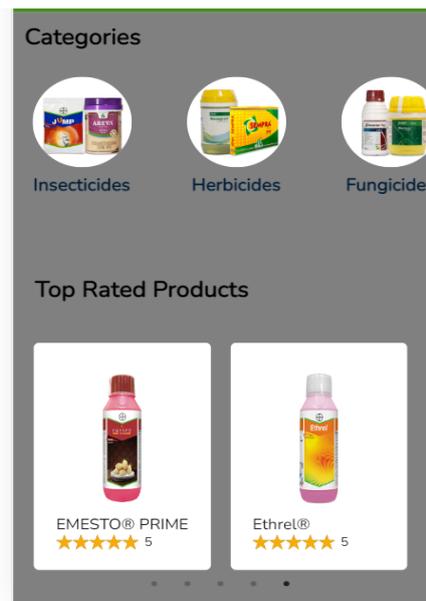


Figure 5.5: Users Home Page(Mobile View)



Figure 5.6: Single Product Description Page

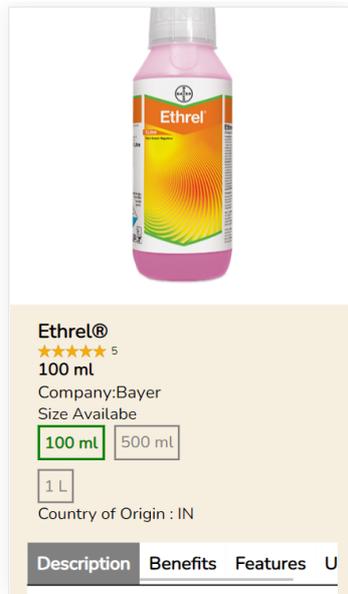


Figure 5.7: Single Product Description Page(Mobile View)