iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 12 **Issue:** IV **Month of publication:** April 2024

DOI: https://doi.org/10.22214/ijraset.2024.59954

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue IV Apr 2024- Available at www.ijraset.com

RECBOT: Web-based Laptop Recommendation using Machine Learning

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Abstract: ***In today's rapidly evolving consumer electronics market, individuals often face challenges when purchasing laptops or computer devices. Common issues include being sold older generation devices at inflated prices, leading to dissatisfaction and inefficiency. To address this problem, we developed a website aimed at helping consumers make informed purchasing decisions. Through a comprehensive literature review and user feedback, we identified key factors influencing consumer behavior and the need for a solution to facilitate wise buying choices. Our website offers a user-friendly platform where users can search for and compare laptop models, access pricing information, and make educated decisions based on their specific needs and preferences. This paper outlines the development process of the website, its features and functionality, and evaluates its effectiveness in assisting users in avoiding common pitfalls and selecting suitable devices. Our findings underscore the significance of such tools in empowering consumers and enhancing their purchasing experiences in the consumer electronics market.***

Keywords: Consumer electronics, Laptop purchasing, Computer devices, Informed decision- making, Consumer behavior, Website development

I. INTRODUCTION

A. Context

In today's tech-driven world, the demand for laptops is widespread, yet many consumers struggle to make informed purchasing decisions amidst the myriad of options available. This challenge is exacerbated by the prevalence of outdated models sold at inflated prices, particularly affecting students, seniors, and educational institutions. Our research addresses this issue by developing a user-friendly website aimed at empowering consumers to choose the right laptop based on their needs. Through a thorough examination of consumer behavior and market trends, we provide users with the tools and knowledge necessary to navigate the electronics market confidently.

B. Motivation

Our research is driven by the pressing need to address the pervasive challenges encountered by consumers when navigating the complex landscape of laptop and computer device purchases. With the market inundated by an overwhelming array of options, coupled with the prevalence of unethical practices such as selling outdated devices at inflated prices, individuals, particularly students, seniors, and educational institutions, often find themselves grappling with confusion and frustration. This discrepancy in knowledge and resources highlights the urgency to empower consumers with accessible tools and reliable information to make informed decisions, ultimately fostering a more equitable and transparent marketplace.

In response to these challenges, our research endeavors to develop a user-friendly website tailored to provide consumers with transparent and reliable information about laptop and computer devices. By offering accessible resources and guidance, we aim to empower consumers to navigate the electronics market confidently and find devices that best suit their needs and budget. Through our efforts, we seek to level the playing field and promote consumer empowerment, ultimately contributing to a more equitable and consumer- centric marketplace for laptop and computer devices.

C. Need of Research

The research is crucial to address the myriad challenges consumers face in the modern consumer electronics market, particularly regarding the selection of laptops and computer devices. With a plethora of options available and the prevalence of unethical practices like selling outdated devices at inflated prices, consumers, particularly students, seniors, and educational institutions, encounter significant obstacles in making informed decisions.

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Research in this realm is vital to empower consumers with the requisite knowledge and tools to navigate the market confidently and discern between options effectively. By comprehending consumer behaviors, preferences, and market trends, we can develop tailored solutions such as our user-friendly website, which provides transparent information and comparative analysis of devices. Through our research efforts, we aim to promote transparency, empower consumers, and cultivate a more equitable and consumer-centric electronics marketplace where individuals can find devices that best suit their needs and budget, ultimately enhancing their productivity and satisfaction without facilitating direct purchases through our platform.

II. LITERATURE SURVEY

1) Title: Laptop Recommendation Intelligent Virtual Assistant using Recurrent Neural Network with RPA for Data Scraping
Publication year: 2023
Findings: The study found that Virtual Assistants for laptop recommendations are highly accurate, achieving a 96% success rate in responding to user queries. They use advanced technologies like
Recurrent Neural Networks (RNN) and tools like UiPath and Robotic Process Automation (RPA) to gather data efficiently from online sources, improving recommendation quality. However, the assistants struggle with unconventional user inputs, suggesting areas for improvement. Overall, the study highlights the significant role of Virtual Assistants in providing personalized support services and suggests exciting possibilities for future advancements in AI-driven technologies. [1]

2) Title: Is UGC sentiment helpful for recommendation? An application of sentiment-based recommendation model
Publication year: February 2024
Findings: In this study, authors investigate the impact of user-generated content (UGC) on e- commerce, focusing on its role in purchase decisions and recommendations. Conducted on Douban, a major UGC platform in China, the research introduces innovative recommendation models integrating sentiment analysis: Collaborative Filtering recommendation model based on sentiment (SCF) and Hidden Factors Topics recommendation model based on sentiment (SHFT). Results show sentiment significantly influences purchase intentions, with sentiment-based models outperforming traditional approaches. The study offers insights for refining recommendation strategies, suggesting integrating UGC sentiment into websites and tailoring strategies based on product types. These findings hold practical value for optimizing e-commerce recommendation systems.[2]

3) Title: A Hybrid Model for Specialization-Based Laptop Recommendation System
Publication year: July 2023
Findings: The study reveals a research gap in laptop recommendations despite extensive literature on recommendation systems. Limited attention has been given to laptops, which are essential, especially among undergraduates. To address this, the study investigated the role of online reviews in aiding laptop purchasing decisions for engineering students. Using Python's pandas library, it identified key factors like processor, OS, graphics card, and RAM. Additionally, it proposed a specialized recommendation system blending Content-Based Filtering and Collaborative Filtering for personalized advice. [3]

4) Title: Effects of the Conversation and Recommendation Mechanism on Chatbots' Recommendation Effectiveness
Publication year: November 2023
Findings: By running a situational experimental study, the authors looked at how the chatbot's conversational skills and how relevant the product recommendation is affect how effective the recommendation is. The findings show that when the product recommendation is really relevant, having a chatbot that talks more and interacts better actually helps. But, interestingly, when the recommendation isn't as relevant, having a chatty chatbot can backfire. The authors also plan to dive deeper into how people feel about chatting with these bots and how that affects their expectations in future studies. It's a pretty cool look at how chatbots can be more than just helpful assistants—they can actually make our online shopping experiences better, as long as they get it right.[4]

5) Title: Chatbot commerce - How contextual factors affect Chatbot effectiveness
Publication year: May 2023
Findings: This paper delves into how Chatbots are reshaping sales via chats and bots, particularly in mobile commerce. While Chatbots garner attention, their effectiveness varies across different shopping scenarios.

The authors examined factors such as task complexity and shopping companionship's impact on users' perceptions of Chatbot recommendations on mobile devices. Drawing on cognitive load theory and common ground theory, they conducted experiments to analyze data. Results show that Chatbots perform well in simpler tasks with less information, especially when users shop with friends. However, traditional apps remain superior for complex tasks. These findings are pivotal for enhancing Chatbot performance and improving user experiences in mobile shopping.[5]

6) *Title: Increasing the Effectiveness of Prediction in Recommendation Engines Based on Collaborative Filtering*

Publication year: March 2024

Findings: This study explores collaborative filtering in recommendation systems to refine prediction algorithms for personalized content suggestions. By investigating collaborative filtering techniques, it identifies challenges and proposes innovative strategies to enhance prediction accuracy. Using Java programming and real-world datasets from Movie Lens, experiments yield promising results. The proposed model outperforms established algorithms like PMF, HPF, and NMF, indicating its potential to revolutionize personalized content recommendation. Additionally, it uncovers insights into group preferences, enriching user experiences by connecting like-minded individuals. These findings significantly contribute to advancing recommendation systems, providing valuable insights for researchers and practitioners in delivering refined personalized content suggestions. [6]

7) *Title: Post-Purchase Dissonance Among Laptop Consumers in India*

Publication year: August 2023

Findings: In today's competitive marketplace, brands increasingly focus on delivering exceptional customer experiences throughout the entire journey. Post-purchase satisfaction, especially for consumer electronics like laptops, plays a crucial role in brand success. This study examines the post-purchase satisfaction and dissonance of 308 laptop buyers in India, highlighting factors influencing buyer satisfaction and dissonance. Critical elements such as 'Basic functions and features,' 'Pricing and post- purchase experience,' and 'Product design' significantly impact buyer satisfaction. Additionally, post-purchase dissonance includes factors like 'Emotional state' and 'Deal concerns.' Notably, online buyers exhibit lower levels of dissonance. These insights aid retailers and brands in understanding and addressing post-purchase experiences, enhancing customer satisfaction and loyalty. [7]

8) *Title: Visual design and online shopping experiences: When expertise allows consumers to refocus on website attractiveness*

Publication year: May 2022

Findings: This study explores the intricate link between visual design and consumer behavior in online shopping. Previous research suggested a positive connection, but findings were inconsistent. Researchers focused on two variables: website use and user expertise, to clarify this relationship. Their findings showed that the impact of visual design on consumer intentions varied depending on when the website was evaluated—before or after use. Moreover, user expertise significantly influenced perceptions, especially after website use. These insights offer valuable guidance for e-retailers aiming to enhance their websites and improve the online shopping experience for customers.[8]

9) *Title: Laptop Performance Prediction*

Publication year: March 2023

Findings: This study zeroes in on refining the system and architectural design processes for parallel computers, aiming to streamline these procedures. The methodology involves extracting performance data from a subset of machines within the design spectrum and leveraging this information to construct machine learning models capable of predicting the performance of any machine across the entire design spectrum. Such predictions prove invaluable for expediting design space exploration, ultimately leading to reductions in research and development costs, as well as time-to-market for laptops.[9]

10) *Title: Analysis of Factors Influencing Laptop Purchase Decisions*

Publication year: November 2023

Findings: This study aims to delve into the considerations driving laptop purchases. Employing tools from linear regression analysis, the methodology incorporates quantitative descriptive techniques.

Data collection is facilitated through the use of the Likert scale via SPSS version 27, with a sample of 200 students drawn from the student body of APP Polytechnic, all of whom are laptop users. Analysis of the data using t-tests reveals that price, brand image, and quality exert a positive and significant influence on purchasing decisions. Additionally, the F-test results indicate that these variables collectively account for 13.7% of the variance, with the remaining 86.3% attributed to other factors. These findings shed light on the multifaceted nature of consumer preferences and contribute valuable insights to the field of consumer behavior.[10]

11) Title: Enhancing Performance of Movie Recommendations Using LSTM With Meta Path Analysis
Publication year: January 2023
Findings: This study introduces LSTM-IIMA, a framework for movie recommendation systems integrating intra and inter metapath analyses. Intra metapath analysis explores interactions within a single metapath, while inter metapath analysis examines connections between multiple metapaths. LSTM-IIMA leverages these analyses to capture rich linkages in movie recommendation systems. Each metapath sequence captures user interactions with films and other entities, enabling LSTM to model temporal dependencies and entity interactions. The model is trained using supervised learning to optimize parameters and minimize prediction errors. Evaluation metrics include precision, recall, ablation analysis, time efficiency, and AUC. Comparative analysis against techniques like HAN and MAGNN demonstrates LSTM-IIMA's superiority, representing a significant advancement in movie recommendations. [11]

12) Title: Chatbot using NLP
Publication year: December 2022
Findings: The paper highlights the importance of chatbot technology in modern online communication. Positioned as alternatives to live human chat operators, chatbots efficiently mediate between users and machines, deciphering inquiries and generating relevant responses through data integration. Natural Language Processing (NLP) is essential for chatbots to process natural language inputs effectively. The project discussed focuses on developing a chatbot system for college inquiries, emphasizing its ability to provide comprehensive responses regarding college infrastructure and courses. By facilitating seamless interactions and access to information, the chatbot project aims to enhance user engagement and streamline the process of seeking college-related information. [12]

III. SYSTEM DESIGN

A. Aim

The aim of this project is to develop a user-friendly website that empowers consumers, particularly students, seniors, and educational institutions, to make informed decisions when selecting laptops and computer devices. By providing transparent information and comparative analysis of device specifications, features, and pricing, the website aims to alleviate the challenges faced by consumers in navigating the complex consumer electronics market. The primary objective is to enable users to identify and choose devices that best suit their individual needs and preferences, ultimately enhancing their productivity and satisfaction without facilitating direct purchases through the platform. Through this initiative, we seek to promote transparency, empower consumers, and foster a more equitable and consumer-centric electronics marketplace.

B. Objective

1) Develop a user-friendly website interface tailored to the needs of consumers, ensuring ease of navigation and accessibility for individuals with varying levels of technical expertise.
2) Aggregate comprehensive and up-to-date information on a wide range of laptop and computer devices, including specifications, features, and pricing, to provide users with a holistic view of available options.
3) Implement robust search and comparison functionalities that enable users to filter devices based on specific criteria and conduct side-by-side comparisons to facilitate informed decision-making.
4) Conduct thorough research and analysis of consumer behaviors, preferences, and pain points to inform the design and development of the website, ensuring alignment with the needs of target users.
5) Provide educational resources and guidance to empower users with the knowledge and tools necessary to evaluate devices effectively and make informed decisions that align with their individual needs and preferences.
6) Solicit feedback from users throughout the development process and iterate on website features and functionalities based on user input to enhance usability and effectiveness.

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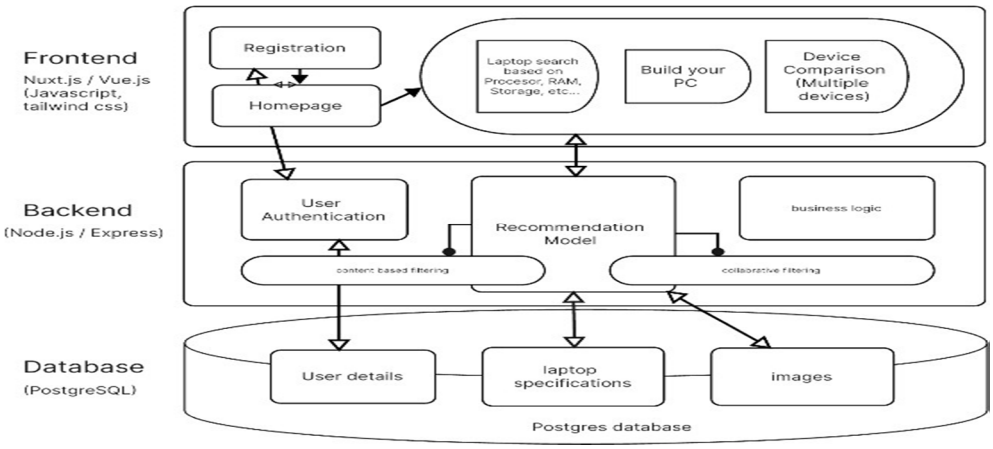
7) Evaluate the impact and effectiveness of the website in empowering consumers and facilitating informed decision-making through user surveys, feedback analysis, and quantitative metrics tracking.
8) Disseminate findings and insights gained from the project through academic publications, presentations, and other channels to contribute to the body of knowledge on consumer electronics purchasing behavior and market dynamics.

C. *Problem Statement*

In the contemporary consumer electronics market, consumers, including students, seniors, and educational institutions, face significant challenges when purchasing laptops and computer devices. These challenges are exacerbated by the abundance of options available, coupled with the prevalence of unethical practices such as selling outdated devices at inflated prices. As a result, consumers often struggle to make informed decisions, leading to dissatisfaction and inefficiency. The lack of accessible resources and transparent information further compounds these challenges, hindering consumers from navigating the market effectively and finding devices that align with their needs and budget. Consequently, there is a pressing need for a solution that empowers consumers with the knowledge and tools necessary to make informed purchasing decisions, thereby promoting transparency and enhancing consumer satisfaction in the consumer electronics marketplace.

IV. SYSTEM ARCHITECHTURE

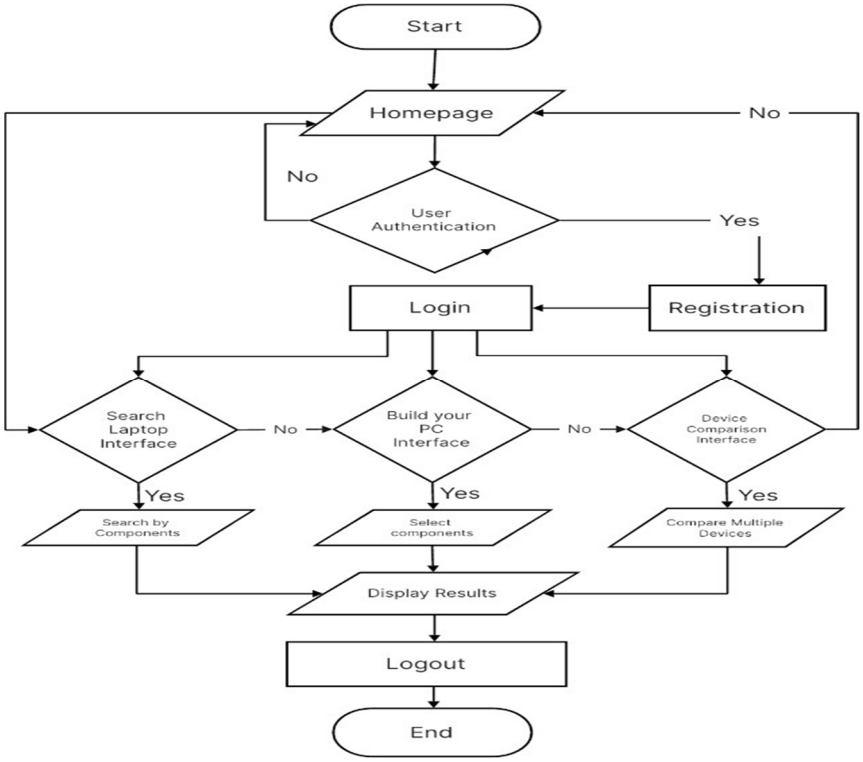
1) Frontend (Nuxt.js/Vue.js): The frontend, developed with Nuxt.js/Vue.js, provides an intuitive user interface for seamless interaction. Components include search, build PC, and compare laptops interfaces, each facilitating specific user actions.
2) Search Laptops Interface: Users search for laptops based on criteria like processor, RAM, and budget. They input specifications or select options from dropdown menus. The interface communicates with the backend via API requests to retrieve relevant data, allowing users to view search results, filter them, and compare models.
3) Build PC Interface: Empowers users to customize PCs by selecting components like CPU, GPU, and RAM. They browse a catalog, view specifications, and add items to virtual builds. Real-time feedback ensures compatibility and optimized configurations. Users can save builds for future reference or feedback.
4) Compare Laptops Interface: Users compare laptop specifications side by side, selecting models from search results or saved configurations. The interface displays detailed specs, including processor, RAM, and price, allowing users to customize views and make informed decisions.
5) Backend (Node.js/Express): The backend, built with Node.js/Express.js, handles client requests, executes business logic, and interacts with the database. It comprises modules such as the recommendation and comparison engines.
6) Database (PostgreSQL): PostgreSQL stores laptop data, including specifications and user reviews. Offering ACID compliance and advanced features, it efficiently manages data storage and retrieval, making it suitable for large volumes of data.
7) Recommendation Engine: Analyzes user preferences and browsing history to generate personalized recommendations. It utilizes machine learning algorithms to predict laptops matching user requirements, continuously learning and improving over time.
8) Comparison Engine: Facilitates side-by-side comparisons of laptops across various parameters. It provides visualizations and detailed breakdowns to help users identify strengths and weaknesses, aiding informed purchasing decisions.



V. METHODOLOGY

1) Requirements Gathering: Define specific website requirements and goals, considering user functionalities, system capabilities, and performance objectives. Conduct market research and analyze user preferences to prioritize features and design decisions.
2) Frontend Development: Design frontend components (search laptops, build PC, compare laptops) using wireframes and mockups.
   Develop frontend components using Nuxt.js/Vue.js, ensuring responsiveness and usability across devices and browsers.
   Implement client-side logic for user interactions, form submissions, and API requests to the backend.
3) Backend Development: Design backend architecture using Node.js with Express.js, defining routes and middleware for HTTP requests.
   Set up RESTful API endpoints for communication between frontend and backend, ensuring security and data validation.
   Implement business logic for recommendation engine, comparison engine, and database interactions with PostgreSQL.
4) Database Setup: Design database schema for storing laptop data, component specifications, user profiles, and session information.
   Create tables, indexes, and constraints in PostgreSQL to ensure data integrity and consistency.
   Populate the database with sample data for testing and development purposes.
5) Recommendation Engine: Implement recommendation algorithms, leveraging machine learning techniques for personalized recommendations.
   Train the recommendation model using historical user data to generate real-time suggestions based on user preferences.
6) Comparison Engine: Develop algorithms for comparing laptops across various specifications and features.
   Design interactive visualizations for side-by-side comparisons, enabling users to make informed decisions.
7) Testing and Quality Assurance: Conduct comprehensive testing to identify and resolve bugs, errors, and usability issues.
   Perform unit, integration, and end-to-end tests to validate functionality, performance, and security.
   Gather feedback from beta testers and stakeholders for further refinement.
8) Deployment and Maintenance: Deploy the website to a production environment using cloud hosting services for scalability and reliability.

Monitor system performance and security, implementing tools for proactive issue detection. Regularly update and maintain the website based on user feedback and industry trends.



VI. REQUIREMENTS

A. Hardware Requirements

1) Processor (For image analysis and building models): A multi-core processor is recommended for efficient processing. A processor from the Intel i3 8th gen or i5 8th gen series, or an equivalent AMD processor, would be suitable.
2) RAM (For image analysis and building models): A minimum of 4GB of RAM is recommended. More RAM may be required.
3) Storage: An SSD (Solid State Drive) with at least 256GB of storage is recommended for faster read/write speeds.
4) GPU (Optional): for visualization and processing we need integrated GPU or dedicated GPU from NVIDIA also works.
5) Microphone: Since audio analysis is part of the project, a good quality microphone is required for capturing and processing audio data.

B. Software Requirements

1) *Frontend Development:*

- Code Editor: Visual Studio Code (VS Code) is the preferred code editor for its robust features, extensions, and support for web development.
- Version Control: GitHub will be used for version control management, providing a centralized repository for collaboration and code sharing among team members.
- Node.js: Required for running build tools, package managers, and development servers to facilitate frontend development.
- Nuxt.js: Utilized as the framework for Vue.js applications, providing server-side rendering, routing, and other essential features for building the frontend of the website.

2) *Backend Development:*

- Node.js: The backend development will be powered by Node.js, offering a JavaScript runtime environment for building server-side applications.
- Express.js: Express.js will serve as the web application framework for Node.js, providing essential middleware and routing functionalities for handling HTTP requests.
- PostgreSQL: PostgreSQL will be used as the relational database management system for storing and managing data, offering scalability and robust features for data handling.
- pgAdmin: pgAdmin will serve as the database administration tool for managing PostgreSQL databases, providing a graphical interface for database administration tasks.

3) *Machine Learning (Recommendation Engine):*

- Python: Python will be utilized for developing the recommendation engine, leveraging its rich ecosystem of libraries and tools for machine learning.
- Jupyter Notebook: Jupyter Notebook will be used as an interactive computing environment for prototyping and experimenting with machine learning algorithms, facilitating exploratory data analysis and model development.
- Scikit-learn: Scikit-learn, a popular Python library for machine learning, will be used for building recommendation models, offering a wide range of algorithms and tools for predictive modeling.

VII. PARTIAL IMPLEMENTATION

As of the current stage of development, significant progress has been made in

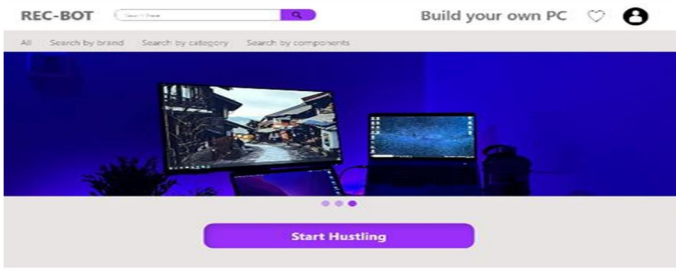


Figure 1 welcome page without Sign up/in

1) Signup Page:

First name: Field for the user first name. Last name: Field for the user last name.
Username: Field for the user to enter their desired username.
Email: Field for the user to enter their email address. Password: Field for the user to create a password.
Confirm Password: Field for the user to re-enter their password for confirmation.
Sign Up Button: Button to submit the signup form. Validation:
Ensure that all fields are filled out correctly before allowing the user to submit the form.
Display error messages if any fields are missing or if the password and confirm password fields do not match.
Validate email format to ensure it is in the correct format.



Figure 1 Sign in page

2) Sign in Page:

Username or Email: Field for the user to enter their username or email address.
Password: Field for the user to enter their password.
Forgot Password Link: Link to reset the password if forgotten.
Sign in Button: Button to submit the login form. Validation:
Ensure that both the username/email and password fields are filled out before allowing the user to submit the form.
Display error messages if the credentials provided are incorrect or if the account is not yet registered.

3) Welcome page:

Figure 2 shows the welcome page of our website before user Sign up/in to our website. It is compulsory for user to Sign up/in with valid information to access our website.

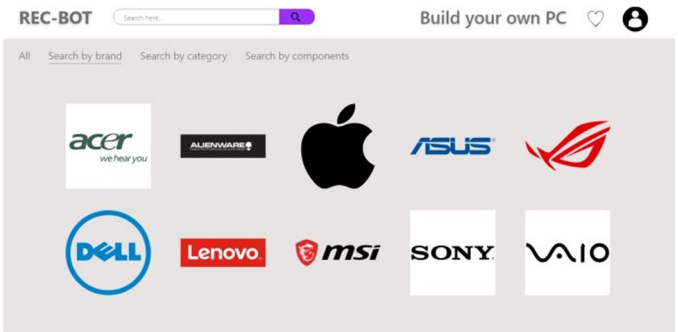


Figure 2 search by brand

4) Search by brand page:

User can hustle by brand in our website by accessing 'Search by brand' page. It allows user to hustle with their favorite brand.

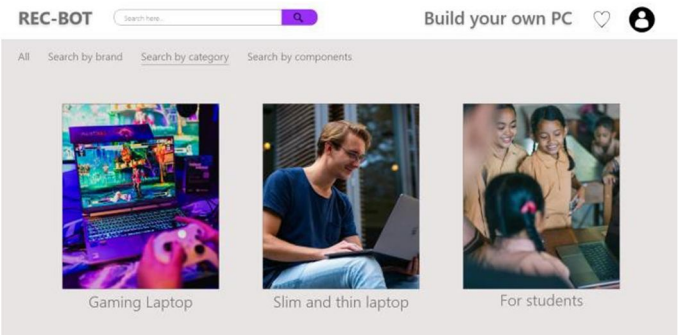


Figure 3 Search by category

5) Search by category:

In this page user can search device with specific categories, we have already implemented three main categories 'Gaming laptops' for student, Gamers and content creator for heavy task managing, 'Slim and thin laptops' for working professionals as they need to carry there devices with, this category mainly focus on light weight and 6+ hours of battery backup, now the last category 'for students' in this category students can find laptops which are suitable for their college work.

We are still working on two more categories for Institutes and work area like IT offices.

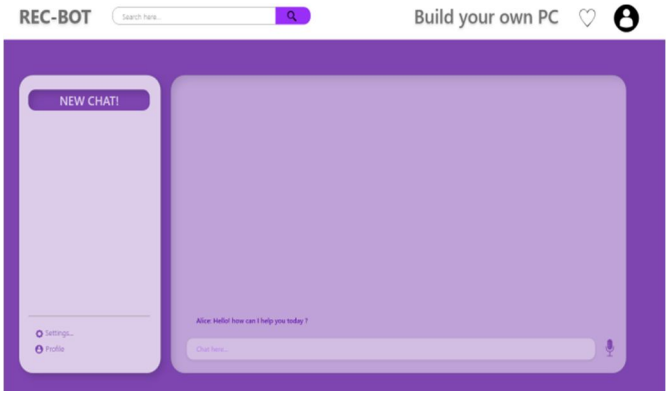


Figure 4 Build your own PC

6) Build your own PC:

As we mention in our introduction, we are working on our own AI which help user to answer their question regarding PCs. User can ask our AI questions related to device, hardware, software and many other stuff related to Computers.

VIII. RESULT

Vue.js and Nuxt.js are both popular JavaScript frameworks used for building web applications, but they serve different purposes and have distinct features. Here's a comparison between Vue.js and Nuxt.js:

1) Purpose:

- Vue.js: Vue.js is a progressive JavaScript framework that is primarily focused on building user interfaces and single-page applications (SPAs). It provides a flexible and scalable architecture for developing interactive web applications.
- Nuxt.js: Nuxt.js is a framework built on top of Vue.js that is specifically designed for creating server-side rendered (SSR) applications and static websites. It simplifies the process of building universal Vue.js applications by providing out-of-the-box solutions for SSR, routing, and more.

2) Routing:

- Vue.js: Vue.js provides basic routing capabilities through its official router library, Vue Router. Developers need to set up and configure routes manually in Vue.js applications.

- Nuxt.js: Nuxt.js simplifies routing by automatically generating routes based on the file structure of the project. It uses a file- based routing system where routes are defined by the file structure in the pages directory. This makes it easier to create and manage routes in Nuxt.js applications.

3) Server-Side Rendering (SSR):

- Vue.js: Vue.js does not provide built-in support for server-side rendering out of the box. However, it can be integrated with server-side rendering solutions like Nuxt.js or used with libraries like Vue Server Renderer for SSR.
- Nuxt.js: Nuxt.js is specifically designed for server-side rendering and provides built-in support for SSR. It simplifies the process of implementing SSR by handling server-side rendering configuration and optimizations automatically.

4) File Structure:

- Vue.js: Vue.js does not enforce any specific file structure for organizing code. Developers have the flexibility to structure their Vue.js projects based on their preferences or project requirements.
- Nuxt.js: Nuxt.js follows a convention-based file structure where different types of files are organized into specific directories such as pages, components, layouts, middleware, etc. This structured approach simplifies project organization and makes it easier to navigate and maintain code.

5) SEO and Performance:

- Vue.js: While Vue.js does not provide built-in support for server-side rendering, it can still achieve good SEO and performance through client-side rendering (CSR) and optimizations such as code splitting and lazy loading.
- Nuxt.js: Nuxt.js offers built-in support for server-side rendering, which improves SEO by pre-rendering pages on the server and delivering fully rendered HTML to the client. This results in better search engine indexing and improved performance, especially for initial page loads.

IX. CONCLUSION

In conclusion, our research project addresses the challenges faced by consumers, especially students, seniors, and educational institutions, in purchasing laptops and computer devices. Through our user- friendly website, we provide transparent information and comparative analysis to empower consumers in making informed decisions.

Our efforts contribute to promoting transparency and enhancing consumer satisfaction in the electronics marketplace. We remain committed to ongoing refinement of the website based on user feedback, aiming to foster a more consumer-centric market. Ultimately, our goal is to advocate for consumer empowerment and contribute to a more efficient electronics marketplace.

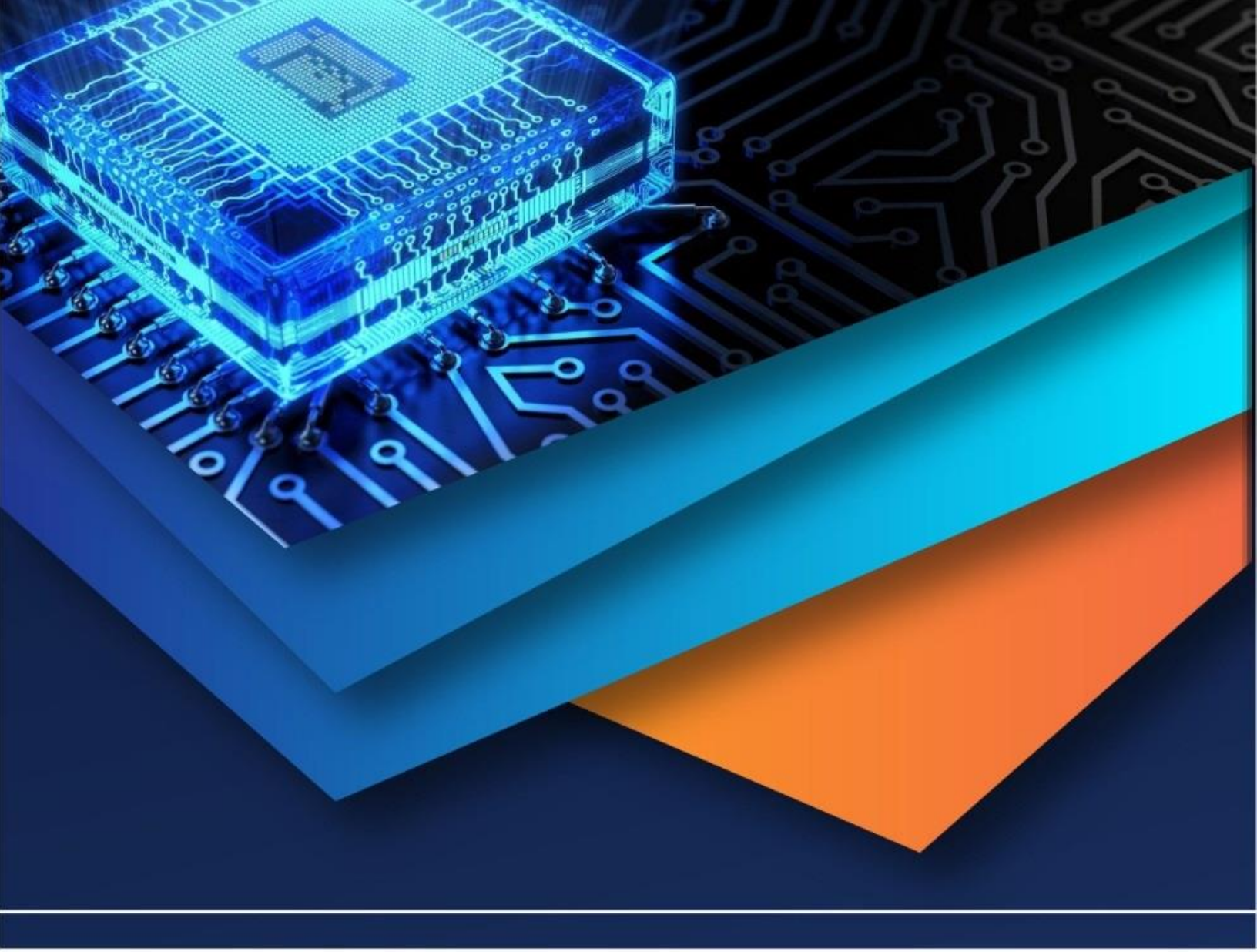
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