An Efficient Artificial Intelligence (AI) & Internet of Things (IoT's) Based MEAN Stack Technology Applications

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Abstract

This paper examines the components of the MEAN development stack integration with artificial intelligence (AI) and Internet of things (IoTs), we see that we are a part of a society where technology has its roots in every aspect of life. No part of our daily life is not affected by the impact of technology. Such technology has now become an essential core part of our life that we use both consciously and unconsciously. Having such a technology assisting us in our daily needs has brought about extreme changes. People do need to depend on such technology to fulfill their smallest needs today. A greater means is using classified e-commerce stores or classified e-commerce websites for their specific needs. A very large number of people use such e-commerce classified websites daily to buy things like Mobile Phones, Clothing, Electronics Devices, and so on. Given the rising need for such a platform, we have created a platform for buying or selling cars, laptops, or mobile considered in the secondhand or used category with such functionality to provide relatively accurate market prices. Our platform is built with technologies including MongoDB, Angular framework, RxJS, NgRx, HTML, CSS, JavaScript, ExpressJS, NodeJS, Python, Sci-Fi Kit Learn, DialogBox, Stripe APIs, Twilio, Rest APIs, Email Validator. The classified e-commerce website is completely responsive and easy to navigate through pages. An admin panel will manage all the registered users and processing. The website will have multiple pages for the users including Category, Price, FAQ, Contact Us, About Us, Signup/Sign in, Account, and Store. The website interface will change depending on whether the user is logged in or not. For customers, the website will have a search box implemented with NLP technology for customers to search out their exact needs effortlessly. The paper also describes an approach to establishing a secure mechanism for communicating with IoT devices, using pull-communications. Different types of services will be given to customers like smart inspection using AI and limited physical inspection. For premium users, a greater number of services are part of the package.

Keywords: Artificial Intelligence AI, Internet of things IOTs, Classified E-Commerce Platform, Smart Chatbot, Smart Price Prediction Model, MongoDB, Angular framework, RxJS, NgRx, HTML, CSS, JavaScript, ExpressJS, NodeJS, Python, Sci-Fi Kit Learn, DialogBox, Stripe APIs, Twilio

1. Introduction

In Today's world, everyone tries to do everything convenient for them. In this era, everyone goes for a thing which is more time convenient to them. One of the main thing people loves to do is online buying but people are also much concerned about what they see online and what they will get after placing the order. Two categories that are mainly focused on by the youth are Cars and gadgets and more so. For our Final Year Project, we choose to focus on business generated from online resources by innovating or introducing new solutions to the existing websites. Today Everyone likes to buy and sell online because it is more convenient for them. So we worked on this project but we selected a limited category of Cars and Laptops as it is a vast category in itself. We have done different research on the main problem that laptop and car buyers face is that they don't know the exact price of the product according to the specs (Sharma, 2022). There's a point to focus on here is that the existing solutions such as OLX and PakWheels are working on both categories no doubt they are working well but there's a need for innovation in this type of classified website. The consumer wants to get the exact price by comparing the specs and also there should be a more convenient way to search for the product that is the best match according to the information we provide. By considering these problems we worked on this solution and innovated into the existing solutions but we created a new classified website Named "*Swift Buy Hub*". In this project, we consider the consumer's concerns and introduce a price prediction model which is to predict the price of the product according to the specs provided as needs. To support the purpose of easy buying and selling we proposed the solution "Swift Buy Hub" which is a classified ads website where sellers can publish ads and the buyers can get a predicted price as well as enhanced searching in the form of a chatbot for more precise results and market accurate price (Eddie, 2024).

Technology Used to Develop: To develop this website the main concern was on which technology we will work on. Every Stack technology has its own advantages and disadvantages. Choosing the right technology stack for the website is the main key component which resulted in the form of MEAN [3]. For a classified ads E-commerce website choosing MEAN Stack is a valuable solution. Besides this, it is very important to consider the Flexibility and Scalability of a website (Robert, 2024).

2. Literature Review

MEAN stack is the priority choice of developers who want to build large-scale apps and e-commerce projects as it is more scalable and more flexible in any terms. In the literature review we will cover the importance of MEAN Stack to build a classified website and how AI models' integration is sustainable in MEAN technology (Nirgudka, 2017).

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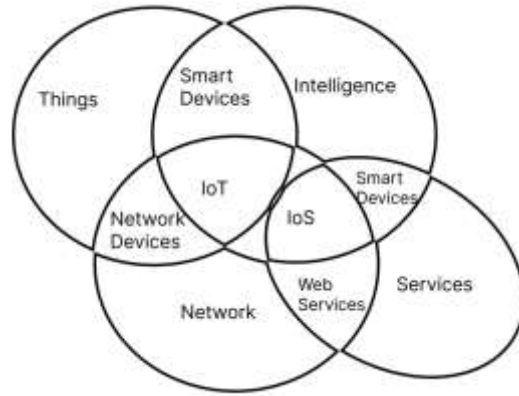
Figure 1: Relationship between IoTs and IoE's (Thakur, 2023)

MEAN stack is a set of JavaScript technologies that allows to creation large scale applications. MEAN stands for MongoDB, Express.js, AngularJS, and Node. These technologies are used to build a robust and scalable web application. MongoDB is a NoSQL database that provides flexible and scalable solutions to store large amounts of data. NoSQL means it is not a relational database. It can store large amounts of data in a minimal number of documents Express is a server-side frame built on Node.js runtime. It is designed to handle client-server interaction. The primary function of Express is to manage routing and support HTTP methods. To achieve these tasks express works on middleware architecture (Thakur, 2024; Bianchi et al., 2024).
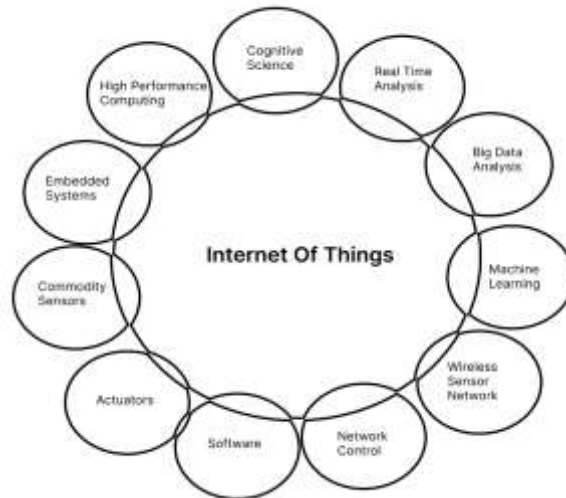

Figure 2: Different Fields Merging into IoT

Angular is an open source JavaScript framework maintained by Google. It is designed for the creation of client-side applications.it is known for developing Single Page Applications (SPAs), it loads the entire website with an initial request which works more efficiently on the client side and also reduces the server load. AngularJS operates on an MVW (Model View Whatever) architecture, providing developers with the flexibility to implement the framework in various ways to suit their project needs (Mondal, 2024).
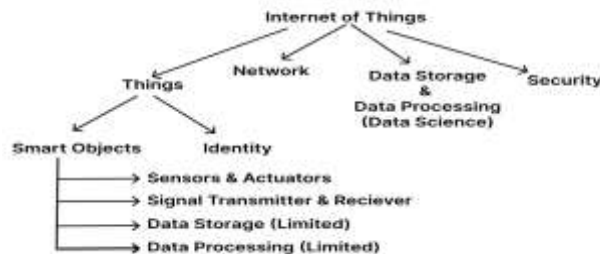
Figure 3: IoT Tree Structure (Soegoto, 2018)

Node.js is a runtime environment for JavaScript built on the Google V8 engine. Node.js utilizes an asynchronous I/O event-driven model, making it ideal for developing scalable network applications (Yazdani, 2022).
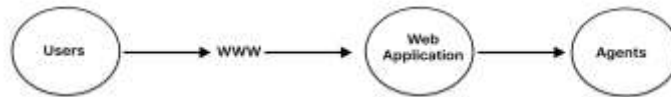
Figure 4: User Access Web Applictaion Via IWA (Sabha, 2016)

2.1. AI Integration with NodeJS

Scalability is the core feature of this web project to deliver its users a fully responsive and scalable experience. AI also being one of the unique core features of this web project helps stand out this project among other relative competitors relatively. Integration of AI with the frameworks of NodeJS or simply MEAN framework is a highly advantageous option. Running AI technologies on other language stacks can be quite challenging at times and cause the desired output to be none of the standard type. On the other hand NodeJS and AI implementation together is quite a different ride (Hsia, 2022).

NodeJS has access to a very large number of potential libraries for such a scale of development ultimately resulting in an excellent high standard-driven product with AI capabilities. NodeJS with AI implementation allows access to libraries such as sci-kit learn, DialogBox & Twilio for chatbots predictive data model recognition system, and even so.

In conclusion, implementing of AI technologies with NodeJS framework is the ultimate step for creating such a highly scalable project with MEAN Stack implemented with AI capabilities like chatbot, predictive data model datasets analysis, or even recognition system of specific products or persons (Duttaroy, 2022).
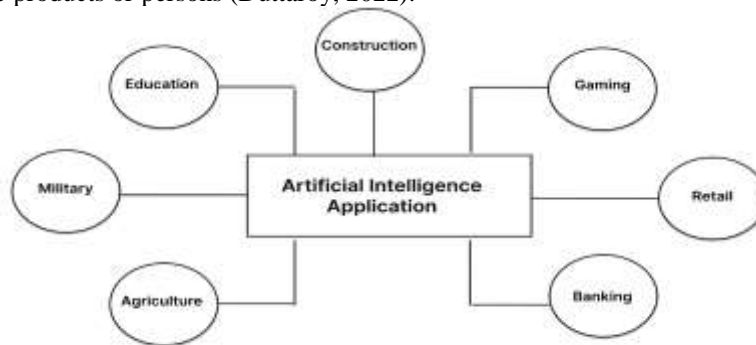
Figure 5: Artificial Intelligence Applications (Chang, 2022)

2.2. Problem Statement

Why the need for such a system occurred while many classified e-commerce websites are already in working. The major challenge is to keep the customers up to date regarding the information about such required products. Less awareness is the major affecting factor which ultimately leads to the creation of such a type of classified e-commerce website project, to give the customers actual awareness of market rates and the actual value of products. The customers do need to be informed about why they are paying such a price what are the factors that are making up the price, is the price being paid is actually valid or not. The market of products dealing in second-hand or used products is majorly a vast one which makes it fairly difficult for buyers and sellers to deal in. We created such a system implemented with the actual capabilities to facilitate the customers so that they are encouraged to buy and sell however the type of products they desire in a trusted environment. Even so, promoting the factor of actually opening the ways to second-hand or used products category market for people. This project aims to address such types of problems leading towards the creation of such a system where users can buy or sell products based on relatively accurate market rates and prices.

3. Methodology

The Methodology of collecting data is majorly based on the secondary Data collection method. The most critical phase of developing a web app is data collection. This phase in developing a swift buy hub, involves gathering of data from different sources or training AI models. OLX and PakWheels to train the AI model for the price prediction, the data is collected from OLX and PakWheels, the data includes price data, product categories, condition or description of the product, and listing. Data from users registering and interacting with Swift Buy Hub, including profile info, Product listings, and description.

3.1. Data collection method

Data that is used to train the AI model is collected from OLX and Pakwheels by using the method of web scrapping. Data collected directly from the user at the time of registration, product listing, and updating product description on Website. Data Analysis includes the processing and analyzing of data to develop an AI model and integration of AI with MEAN stack and enhance platform functionalities.

3.2. Data Processing

The main steps of data processing are cleaning and transformation. Cleaning of data includes removing duplicates, handling missing values, and correcting inconsistencies in the data. transformation includes converting data into a suitable format for analysis, including normalization and feature extraction.

3.3. Model Training

Price Prediction Model: To train a price prediction model we use datasets from OLX and PakWheels we use regression algorithms. Features of the products as price and features of the products are used to predict the price. Training an NLP model on a dataset of common user queries and responses to develop a chatbot capable of understanding and responding to user interactions in natural language.

3.4. Proposed Solution

After considering all the issues consumers face while using other classified websites they are not innovating or introducing new features. Swift Buy Hub utilizes the MEAN stack for its robust and scalable architecture. The platform includes:

i. **User-Friendly Interface -** Swift Buy Hub is working on introducing a user-friendly interface for both web and mobile to ensure easy navigation and a seamless shopping experience.

ii. **Product Catalog -** On this website all product categories will be managed in a proper catalog. Users can easily access whatever category they want. It will make it convenient for the user to use our platform

iii. **AI-Powered Personalization -** For a better experience we introduce a price prediction model for the users who want to compare the price of the product according to the specs they mentioned. This model will fetch the information from the product-specific dataset or data model and they will give a predicted price for the product.

iv. **Security Measures -** Implement robust security protocols to protect user data, and transactions, and ensure a secure online environment.

v. **Search and Filtering -** Develop advanced search and filtering options to help users quickly find products based on various criteria, such as category, price range, and brand giving out the specified needs. For this, we created a chatbot that will enhance the search option and users can see the exact product for the category with the same features they want.

vi. **User Registration and Profiles -** The user will only register one profile to do both tasks. They can buy and sell products from the same profile.

vii. **Messaging System -** Implement a messaging system that facilitates communication between buyers and sellers easily within the platform.

viii. **Product Listing and Management -** Users can easily list their products from their profile and can run classified ads on one. Users can manage the listing and ads from the same panel.

ix. **Physical Inspection -** There will be an additional feature of physical inspection but this feature will be introduced on the premium mode of the website. Users will have to pay for the physical inspection of the product they want to buy.

x. **Scalability and Performance -** Ensure the platform is scalable to accommodate a growing user base and optimized for performance.

3.5. Flowchart / Pseudo Code

This classified e-commerce web-based project works efficiently by registering its users into its database, the users being the customers in roles as buyers for buying products and sellers for selling their products. And the other user is the actual website admin. Both customer-users can use the feature of smart searching integrated with NLP technology. Through smart searching the users can accurately filter out their required needs they demand. Users are shown with a list of products uploaded by the seller that matches the description of their required needs. The buyer will select the product and proceed through it. Selected products will be compared with our actual dataset model regarding the specific product being selected giving out actual accurate market rates. The flowchart will also show the complete working of the process management of users, buying products, buying services, management of categories and so on.
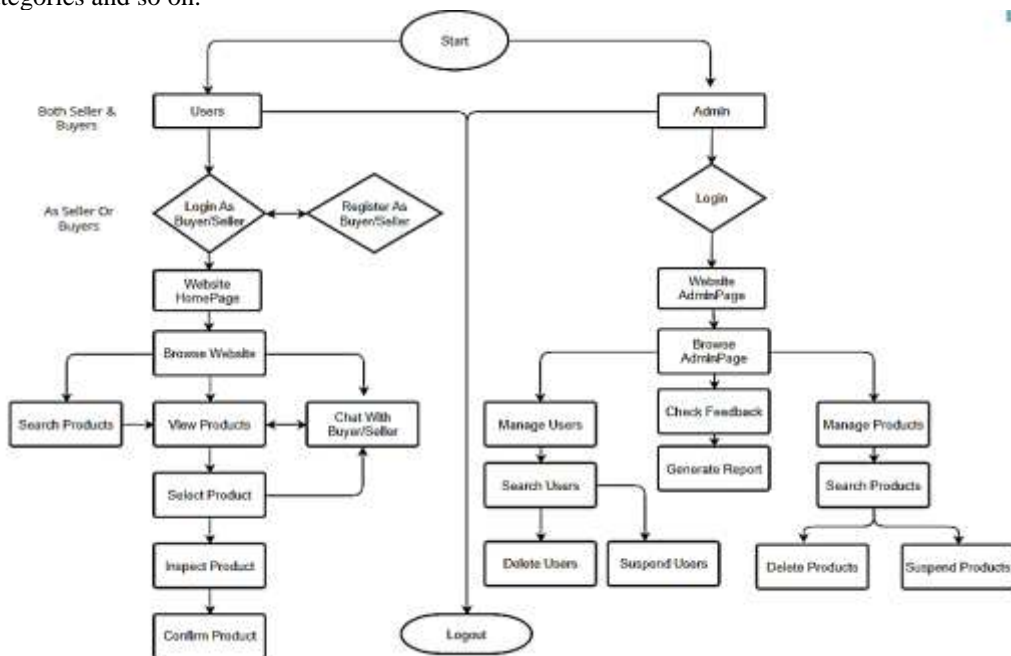

Figure No 6: Flowchart Diagram

The system pseudo code details all the processing of the actual website performing tasks. The tasks being performed the outcome results and the next proceeding steps

1. Start

2. Sign Up an account and log in:

- Function registerUser(userType):

  - Input: userType (buyer/seller), registrationDetails

  - If userType == "buyer":

    - Save buyer details in buyer database

  - Else if userType == "seller":

    - Save seller details in seller database

  - Output: confirmation message

- Function loginUser(credentials):

  - Input: username, password

  - Authenticate user

  - Output: login status (success/failure)

3. Smart NLP-Based Buyer Searches:

- Function searchProducts(searchTerms):

  - Input: searchTerms

  - Use NLP to process search terms

  - Output: list of matching products

4. Product Display List:

- Function displayProducts(productList):

  - Input: productList

  - Display products to user

  - Output: user selection

5. The User Chooses the Products:

- Function chooseProducts(selectedItems):

  - Input: selectedItems

  - Add selected items to user's cart

  - Output: updated cart

Figure 7–8: Pseudo Code

6. Start Chatting with the Seller:

- Function startChat(sellerId):

  - Input: sellerId, message

  - Initialize chat session with seller

  - Output: chat interface

7. Examining AI Models:

- Function compareWithAIModel(selectedItems):

  - Input: selectedItems

  - Use AI to analyze and compare items

  - Output: estimated cost and comparison details

8. Bid-Seller Discussion:

- Function bidDiscussion(bidDetails):

  - Input: bidDetails (price, terms)

  - Facilitate negotiation between buyer and seller

  - Output: agreed terms or updated bidDetails

9. Order Confirmation for Product:

- Function confirmOrder(cartDetails):

Figure 8 - 10: Pseudo Code

3.6. ER Diagram

ERD defines all the relations happening between the users and the products. Which user connects with which user? Which user connects to which category product? What type of product is associated with what category? What features like chats are connected with what users and relations. Features like chats are enabled for which users, and the smart searching feature is related to which functionalities and so explaining all the relationships between the categories and entities.
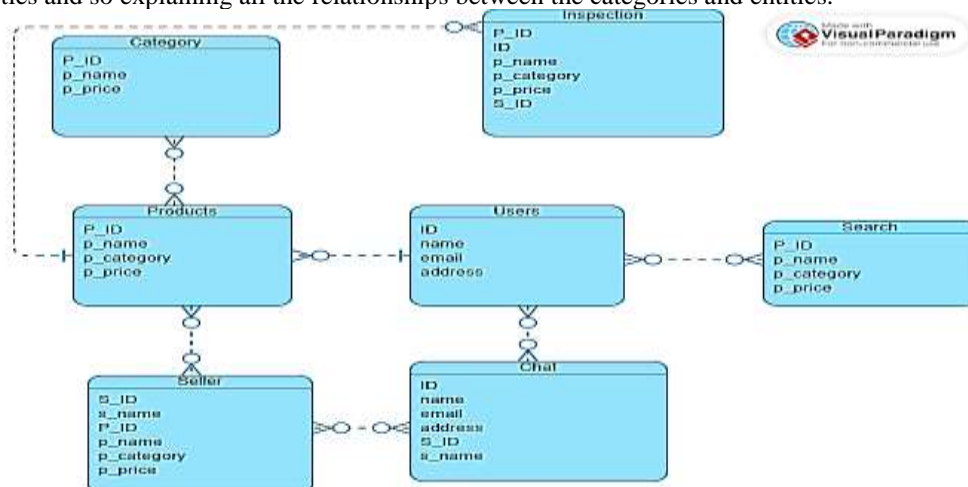
**Figure 11: Entity Relationship Diagram**
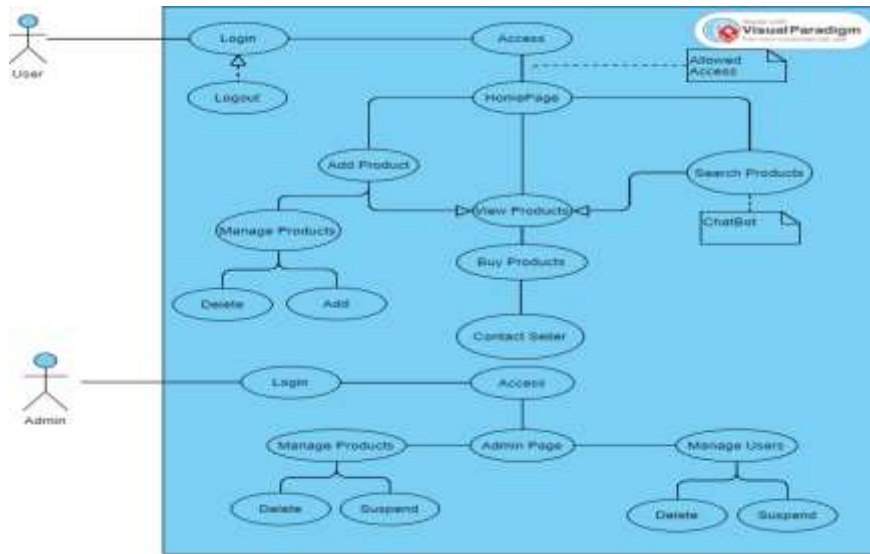
Figure 12: Use Case Diagram

3.7. Use Case Diagram

The use case diagram represents the actors here which are customer with the roles of buyer and seller and the one being the admin of the website. Users log in as either seller or buyer. Being the buyer user can buy products listed by other sellers and on the other hand user being the seller can list products for different buyers to buy. The admin role is defined as different from other users. Admin can manage the products as well as the users. Admin being the only one with the higher authority can deny or remove products as well as accounts of different users. All the records of users and products are also stored at admin`s.

4. Results

Keeping all the needs and requirements of the facing problem regarding the introduction of a classified e-commerce website for second-hand products. We created the solution as an effective classified e-commerce website integrated with AI functionalities. These functionalities are the changing factors that identify our website as unique and propose a better solution in the vast market of buying and selling second-hand products with precisely accurate market rates. This is a revolutionary factor in the existence of this web project which stands out as unique and differently effective than others relatable solutions running in the market. An effective and responsive website with features to easily facilitate the users with their precise needs of buying and selling second-hand products at accurate prices.
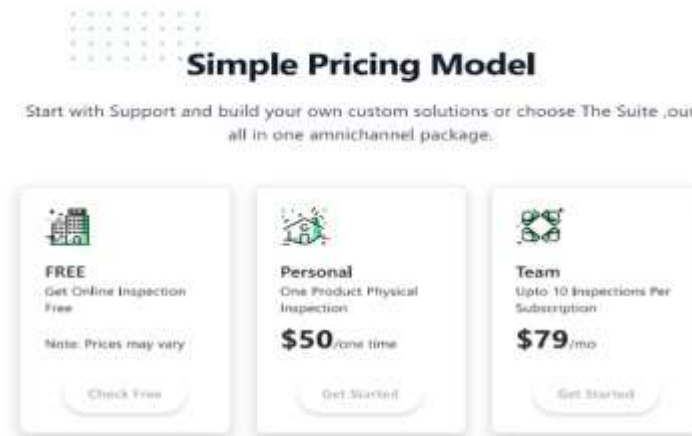
Figure 13: Price Subscription Page

Figure 14: Product Details Page

5. Conclusion & Future Work

Ultimately, our research has concluded the outcome that such a project will have its potential throughout the market and will have an outstanding impact in the market facilitating the users efficiently. Our primary aim was to create such a project with the potential to create a key difference in the market of classified e-commerce which came true with the use of such technologies like Angular Framework MongoDB, framework, RxJS, NgRx, HTML, CSS, JavaScript, ExpressJS, NodeJS, Python, Sci-Fi Kit Learn, DialogBox, Stripe APIs, Twilio, Rest APIs, Email Validator facilitating in creating such a potential web project which ultimately led to users effortless and swift experience. Integrating a smart chat box enhances the user experience. Effortlessly guiding the users towards their desired needs as efficiently as possible. And smart inspection of relatively accurate price modeling of products according to the product`s potential and market rates.

This research has built the foundation for future developments, this research provides insightful information about how to create e-commerce systems that are easier to use and more effective in today`s rising era of technology.

Future Work **-** Keeping your product running is necessary to give out the services needed for customers to get going, but merely running a project it is definitely not enough. As the modern era today keeps on getting advanced it is not to keep standing out with your product as it is. Needs to keep on adapting new technologies, new trends, and new innovative ways to facilitate users as scalability and reliably as possible.

Voice recognition is a heavily advanced and trending feature to use in an e-commerce classified website. Voice recognition backs up the technology of AI implementation. Voice recognition can be used to enhance user experience while using such a project. Voice recognition will be used on the user's login case. It will be a unique and easy feature for users to use the login system by unlocking with your voice. Furthermore, voice recognition can be used for enhance smart chatbots even more. Already implemented smart chatbot searches are an ease for users to type in their requirements in as human manner as possible, with the addition of voice commands such an experience will be enhanced tenfold of times. Facial recognition is a term from which hardly any user is not informed. Facial recognition uses AI/ML technologies like TensorFlow & Keras and. Facial recognition features can be effectively used for logging in securely to website keeping all the data highly secured and accessed quickly. Facial recognition can also be used to confirm orders or even initiate payments methods. Such an approach is highly favorable in today`s era and highly secure. The use of blockchain is also considered a very likely option in today`s businesses. Businesses deal in crypto as payments keeping them up the ladder of technologies and keeping users' information secured and encrypted. Blockchain is a trend used in many businesses today effectively. It will be an ideal one considering dealing with such a scalable e-commerce classified website.

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