

# **Industry Oriented Mini Project Report**

## **E – AUCTION HUB**

A dissertation submitted in partial fulfillment of the

Requirements for the award of the degree of

**BACHELOR OF TECHNOLOGY**

in

**INFORMATION TECHNOLOGY**

Submitted by

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**CERTIFICATE**

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Certified further that to the best of my knowledge, the work in this dissertation has not been submitted to any other institution for the award of any degree or diploma.

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### **DECLARATION**

We hereby declare that the project report entitled **E – AUCTION HUB** is an original work done and submitted to the IT Department, CVR College of Engineering, affiliated to Jawaharlal Nehru Technological University Hyderabad, Hyderabad in partial fulfillment of the requirement for the award of Bachelor of Technology in **Information Technology** and it is a record of bonafide project work carried out by us under the guidance of **Dr. A.Seetharam Nagesh**, Associate Professor, **Department of Information Technology**.

We further declare that the work reported in this project has not been submitted, either in part or in full, for the award of any other degree or diploma in this institute or any other Institute or University.

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## **Abstract**

Traditional auction systems often face challenges like inefficiency, lack of transparency, and security risks. This project addresses these issues by developing a secure, scalable, and user-friendly online auction platform using the MERN stack (MongoDB, Express.js, React.js, Node.js). The backend, powered by Node.js and Express.js, facilitates seamless communication and real-time bidding, while MongoDB efficiently manages user data, auction listings, and bid histories. The React.js-based frontend provides an intuitive interface for users to list items, place bids, and track auctions effortlessly. To ensure security and reliability, the platform integrates JWT authentication, environment variables, and cookie-based session management, alongside payment gateways like Razorpay and PayPal for secure transactions. Use cases include e-commerce expansion, collectible trading, charity auctions, and real estate or vehicle bidding, making it a versatile solution for various industries. With robust middleware for error handling and a well-structured database, this platform redefines online auctions, making them efficient, transparent, and highly scalable

# **1.Introduction**

## **1.1 Motivation**

Traditional auction systems have long relied on physical presence, manual processes, or outdated websites that lack real-time responsiveness and accessibility. With the rise of e-commerce, there is a pressing need for a seamless, secure, and interactive platform that can handle live auctions effectively. This demand is especially relevant for rare, vintage, or high-demand products such as art pieces, antiques, electronics, real estate, or collectibles.

Our motivation for building **E-Auction Hub** is to create a dynamic, real-time, and accessible auction marketplace where users can:

- Participate in live auctions from anywhere.
- Enjoy fair, transparent bidding experiences.
- List their own products for auction.
- Receive real-time updates and notifications.

With the MERN stack (MongoDB, Express.js, React.js, Node.js), we aim to harness modern web technologies to deliver a performant, scalable, and engaging auction experience.

## **1.2 Problem Statement**

The increasing demand for transparent and efficient online marketplaces necessitates the development of robust platforms that can facilitate secure and real-time auction processes. This project aims to address this need by developing a full-stack auction platform using the MERN (MongoDB, Express.js, React.js, Node.js) stack. The platform will enable users to register and manage their profiles, including the upload of profile images, and ensure secure authentication and session management using JWT. Auctioneers will be able to create and manage auction listings, while bidders can browse items, place bids with real-time validation, and track auction statuses. The system will also incorporate features for handling file uploads such as auction item images and payment proofs, managing payment and commission processes, displaying leaderboards,



and providing user-friendly interfaces for both bidders and auctioneers. The successful development of this platform will result in a scalable and interactive online auction experience.

### **1.3 Project Objectives**

#### **1. User Registration & Authentication**

- Implement secure user sign-up/login using JWT and password hashing.
- Separate roles for sellers and buyers.

#### **2. Auction Listing Management**

- Allow sellers to list products with details: title, description, images, base price, auction duration, etc.
- Validate listings before making them live.

#### **3. Real-Time Bidding System**

- Enable live bidding using Web Sockets (Socket.IO).
- Display current highest bid in real-time.
- Auto-close auctions when the time expires.
- Alert users when they are outbid.

#### **4. Auction Dashboard**

- Dashboard for users to track active bids, won auctions, and bidding history.
- Sellers can manage, monitor, and close their listings.

## **1.4 Project Report Organization**

### **Chapter 1: Introduction**

This chapter introduces the concept of online auctions and the growing demand for secure, efficient digital marketplaces. It highlights the limitations of current auction systems, including lack of transparency, real-time interaction, and admin control. The motivation behind this project is to create a user-friendly platform that ensures fairness, transparency, and engagement. The chapter defines the problem statement—building a robust, scalable, and real-time online auction system—and presents the project objectives, which include secure authentication, auction listing, bidding functionalities, admin control, and leaderboard integration. The chapter concludes with an overview of the system architecture and the tools used.

### **Chapter 2: Literature Survey**

This chapter reviews existing online auction platforms and prior research in the domain of e-commerce and real-time systems. It compares popular platforms based on features such as bidding mechanisms, user interface, admin capabilities, and transparency. The shortcomings observed include lack of real-time updates, poor scalability, and limited role-based access. This chapter lays the foundation for understanding the gap in current systems that E-Auction Hub aims to address.

### **Chapter 3: Software Requirements Specifications**

This chapter details the development approach and technologies used. The project uses the MERN stack (MongoDB, Express.js, React.js, Node.js) as its core framework. It also integrates third-party services like Cloudinary for media handling, JWT for authentication, Redux Toolkit for state management, and Postman for API testing. The system requirements include authentication modules, auction management, role-based access for users and super admins, and secure file upload functionalities.

## **Chapter 4: Design**

This chapter discusses the architecture of the E-Auction Hub platform using system design diagrams such as component diagrams, data flow diagrams (DFD), and use case diagrams. It describes how the frontend, backend, and database interact. It also outlines how different modules such as user registration, auction creation, bidding, and leaderboard interact with each other. Middleware is used to protect sensitive routes and enforce role-based access.

## **Chapter 5: Implementation**

The system was implemented using a modular approach across both frontend and backend. The backend includes essential features such as user authentication with JWT token generation and password hashing, auction creation with image uploads through Cloudinary, and super admin functionalities for user and system control. On the frontend, React components were developed for user login, registration, auction creation, item display cards, and leaderboard views. Redux is integrated to manage the application's state efficiently, enabling real-time data updates and smooth user interactions across components.

## **Chapter 6: Testing:**

The application's functionality was thoroughly tested using Postman to validate backend APIs, ensuring reliable operations for login, auction management, and bidding processes. Each API endpoint was tested for correct responses, error handling, and data integrity. On the frontend, UI components were tested interactively to confirm responsiveness and usability across different devices. Screenshots of the user interface and Postman responses were captured to demonstrate the system's accuracy, stability, and integration between frontend and backend components.

## **Conclusion**

The project has successfully met its core objectives by delivering a secure, scalable, and user-friendly online auction platform. Key features such as secure user authentication, efficient auction listing and management, and real-time bid tracking were implemented using the MERN stack. The platform ensures transparent and smooth interactions for both buyers and sellers. Additionally, user roles, bidding logic, and backend operations were effectively managed, offering a seamless experience. The integration of technologies like JWT for authentication, Redux for state management, and Cloudinary for media handling showcases the system's robustness and modular design. This confirms that the foundational goals of the E-Auction Hub have been effectively accomplished.

## **Future Enhancements**

To further enhance the platform's functionality and user engagement, several improvements are envisioned. These include implementing full real-time bidding using WebSocket to ensure instant updates, integrating advanced filtering options to improve auction discovery, and adding support for multiple payment gateways such as Stripe and Razorpay for flexible transactions. Additionally, push notifications can be introduced to keep users informed of bidding events in real-time. A rating and review system will also enhance trust and transparency among users. Long-term plans involve improving scalability, optimizing backend performance, and exploring production deployment strategies to handle larger user bases effectively.

## **2. Literature Survey**

### **2.1 Existing Work**

Several online auction platforms have been developed over the years, with notable examples including eBay, Quibids, and Bidz.com. eBay offers a combination of fixed-price and auction-style listings and has established itself as a global leader, though it lacks advanced real-time bidding features. Quibids introduced the penny auction model, creating a game-like bidding experience but faced criticism over its fairness and transparency. Platforms like Bidz.com and uBid attempted to simplify auction mechanics but failed to scale due to limited adaptability and outdated technologies. Academic research has also contributed by exploring secure bidding algorithms, fraud detection, and bidder behavior analysis, though most studies remain theoretical and are rarely implemented in scalable, production-level systems.

### **2.2 Limitations of Existing Work**

#### **Limitations:**

Many existing auction platforms face several limitations that affect their overall performance and user experience. One major issue is the lack of real-time bidding, where platforms fail to provide instant bid updates. This results in delays during live auctions, leading to a poor and sometimes confusing user experience. Another limitation is the weak role-based access control, where administrators have restricted capabilities to manage users, verify payments, or moderate auction content, making the platform less secure and harder to maintain. Additionally, many platforms suffer from an outdated and cluttered UI/UX, with interfaces that are not user-friendly or optimized for mobile devices. This leads to navigation difficulties and a frustrating experience for users, especially on smaller screens.

## 2.3 Proposed Work

To address the limitations observed in typical auction platforms, E-Auction Hub introduces several key enhancements. For the lack of real-time bidding, the platform integrates WebSockets via Socket.IO, enabling instant communication between clients and the server. This ensures that all users viewing an auction see bid updates in real time, significantly reducing latency and enhancing the bidding experience.

To solve the issue of weak role-based access control, E-Auction Hub implements a robust Role-Based Access Control (RBAC) system. Roles such as Admin, Seller, and Buyer are distinctly separated, with access managed through middleware. The Admin dashboard includes powerful tools for managing users (e.g., banning/unbanning), verifying payments, and moderating auctions—ensuring secure and organized platform management.

For the problem of outdated and cluttered UI/UX, the platform utilizes modern responsive design using Tailwind CSS and React components. The interface follows a mobile-first approach with clean, intuitive layouts and smooth user flows for essential actions like registration, login, bidding, and checkout. Additional features such as dark/light modes and interactive feedback elevate the overall user experience.

## **3. Software Requirement Specifications**

### **3.1 Software Requirements**

#### **3.1.1 Functional Requirements:**

##### **User Authentication:**

- **Sign Up/Registration:** Users must be able to create an account by providing details such as username, email, and password.
- **Sign In/Login:** Registered users should log in using their credentials.
- **JWT-Based Authentication:** Secure login sessions must be maintained using JSON Web Tokens (JWT).

##### **Auction Management:**

- **Auction Creation:** Auctioneers should be able to create auctions by submitting item details, images, base price, and deadlines.
- **Auction Deletion:** Admins must have the authority to remove inappropriate or outdated auction listings.
- **View Auctions:** All users should be able to view current, upcoming, and featured auctions.

##### **Bidding System:**

- **Place Bids:** Registered users should be able to place bids on available items.
- **Bid Validation:** The system should only accept bids higher than the current maximum.
- **Bid History:** A log of all previous bids should be viewable per auction item.

##### **User Interface:**

- **Responsive Design:** The platform must be optimized for desktops, tablets, and smartphones.
- **Intuitive Navigation:** Clear categorization and simple UI for auction browsing, bidding, and dashboard interactions.

**File Uploads:**

- **Cloudinary Integration:** Users must be able to upload images for auction items and payment proof, stored securely using Cloudinary.

**Admin & Super Admin Controls:**

- **Payment Verification:** Admins can view and verify uploaded payment proofs.
- **User Monitoring:** Super Admins should have the ability to monitor and manage users and system activities.

**Leaderboard and Analytics:**

- **Leaderboard Display:** Display top bidders or users based on participation or success metrics.
- **Auction Stats:** Provide insights like highest bid, total bids, and time remaining.

**3.1.2 Non-Functional Requirements:****Performance:**

- **Load Time:** The platform should load within seconds, ensuring smooth interaction for both bidders and auctioneers.
- **Scalability:** The system must efficiently support a growing number of users, auctions, and bids without compromising speed or reliability.

**Security:**

- **Data Protection:** User credentials, bid history, and payment information must be securely stored and encrypted.
- **Authentication:** Robust JWT-based authentication and route protection must prevent unauthorized access to sensitive routes and data.

**Reliability:**

- **Availability:** The platform should offer high uptime to ensure auctions and bidding activities are continuously accessible.



- **Error Handling:** Meaningful error messages and logs should be generated for failed actions, ensuring proper debugging and user guidance.

#### **Usability:**

- **Ease of Use:** The UI/UX should be clean and intuitive, allowing users to browse auctions, place bids, and manage their profiles easily.
- **Accessibility:** The interface should comply with basic accessibility standards (like keyboard navigation and ARIA tags) to support users with disabilities.

#### **Compatibility:**

- **Browser Support:** The application should work smoothly on modern browsers like Chrome, Firefox, Safari, and Microsoft Edge.
- **Device Compatibility:** It must function seamlessly on various devices including desktops, tablets, and smartphones with responsive layouts.

## **3.2 Hardware Requirements**

### **3.2.1 For Development:**

#### **1. Development Workstation:**

- **Processor:** A modern multi-core processor (e.g., Intel i5/i7 or AMD Ryzen 5/7) to efficiently handle code compilation, testing servers, and heavy development tools.
- **RAM:** Minimum of 8 GB RAM to ensure smooth multitasking with code editors, terminal, browser, and testing environments.
- **Storage:** SSD with at least 256 GB for faster data access and ample space for source code, packages, database files, and assets.
- **Network Connectivity:** A stable internet connection to facilitate cloud integration, API access, Git operations, and team collaboration.

### 3.2.2 For Deployment:

#### Cloud Database Hosting:

- **MongoDB Atlas:** A cloud-based NoSQL database service offering scalability, automated backups, and robust performance. Used to store user data, auction items, and bid histories with high availability.

## 3.3 User Requirements

### 3.3.1 Account Information:

- **Email and Password:** Required for user authentication and account recovery. Ensures access control and data security.
- **Username:** A unique identity for each user to manage profiles, bid history, and leaderboard tracking.

### 3.3.2 User Interface Preferences:

- **User-Friendly Navigation:** Interfaces should be intuitive for auction creation, bidding, and browsing auctions.
- **Responsive and Accessible Design:** Must support both light and dark modes, mobile and desktop views, and keyboard-friendly navigation to improve inclusivity.

## **4. Design**

The E-Auction Hub is an online auction platform built with Node.js, Express.js, React.js, and MongoDB, offering a seamless experience for buyers and sellers. The backend handles user authentication with JWT, auction and item management, bidding processes, and real-time updates using WebSockets, ensuring secure and efficient operations. Sellers can create and manage auctions with detailed item descriptions, while buyers can browse, bid, and receive live updates on auction activities. The frontend provides a responsive interface for auction browsing, bidding, and profile management, integrating with the backend API for dynamic data and real-time notifications. With features like user registration, role-based access, live bidding, and structured data storage, the platform ensures a smooth auction experience, with potential for future enhancements such as payment integration, advanced search, and admin tools.

### **4.1. Architecture Overview**

The application architecture follows a three-layered structure consisting of the presentation layer, business logic layer, and data layer.

- 1. Presentation Layer (Frontend):** The frontend is developed using React.js and styled with CSS and reusable components to provide a responsive and interactive user interface. It enables users to browse auctions, place bids, and manage their accounts efficiently. To enhance the user experience, especially in tracking bidding activity, Chart.js is integrated for visualizing patterns and bid history in real time.
- 2. Business Logic Layer (Backend):** The backend is powered by Node.js and structured using Express.js to handle the core functionality of the platform. It processes business logic such as validating bids, managing auction timers, calculating winners, and maintaining user sessions. Additionally, it incorporates role-based access control to differentiate and manage functionalities for admins, sellers, and bidders.

- 3. Data Layer (Database):** The application uses MongoDB Atlas, a cloud-based NoSQL database that supports scalable and flexible data storage. It securely stores structured data including user profiles, product listings, bids, and history logs. CRUD operations are optimized for speed and efficiency, ensuring a seamless experience for users and system administrators.

## Algorithms

- 1. Bid Validation and Processing Algorithm:** When a user submits a new bid for a product, the system checks whether the bid is higher than the current highest and whether it falls within the auction's active timeframe. If valid, the new bid is updated in the database, and a real-time broadcast is triggered to notify all users. This algorithm utilizes Node.js, MongoDB, and WebSockets or polling APIs to ensure up-to-date data across clients.
- 2. Auction Timer and Auto-Closure Algorithm:** This algorithm handles auctions' lifecycle using scheduled start and end times. Background timers are initiated for each auction, and once the end time is reached, the bidding automatically closes. The system then determines the winner, marks the auction as closed, and sends out relevant notifications. Node.js with cron jobs or scheduled events supports this functionality.
- 3. Real-Time Notification System:** To keep users informed of critical changes such as new bids, status updates, or alerts, the system emits real-time notifications using WebSockets or push notifications. These updates instantly reflect on all active user interfaces, enhancing user engagement and platform interactivity. Socket.io is used in conjunction with React for seamless frontend updates.
- 4. Bidding History Visualization:** The system aggregates and sorts bidding data by time and user to generate a comprehensive view of an auction's activity. This information is displayed through dynamic charts and graphs that illustrate bidding trends and competitiveness. The implementation relies on MongoDB aggregation pipelines, Chart.js for rendering, and React for integration.

**5. User Role Management Algorithm:** Upon login, user credentials are authenticated, and appropriate roles (admin, seller, or bidder) are assigned. Based on the assigned role, the user interface and accessible features are customized accordingly. This logic is secured using JWT-based authentication and role-based authorization mechanisms.

## 4.2 Use-Case Diagram

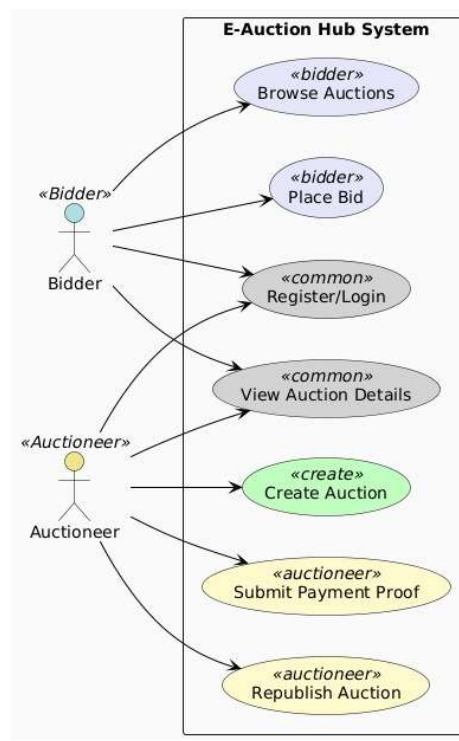


Fig 4.2: Use Case Diagram

### 4.3 System Architecture Diagram

#### E-Auction Hub - Layered Architecture Diagram

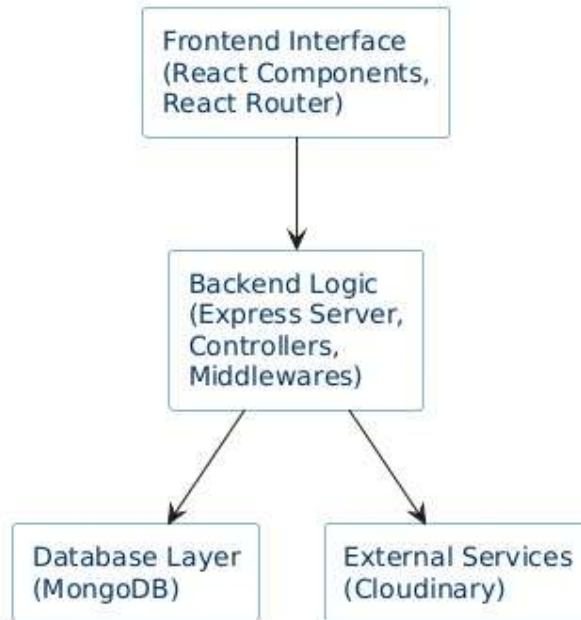


Fig 4.3 : Architecture Diagram

## 4.4 Class Diagram

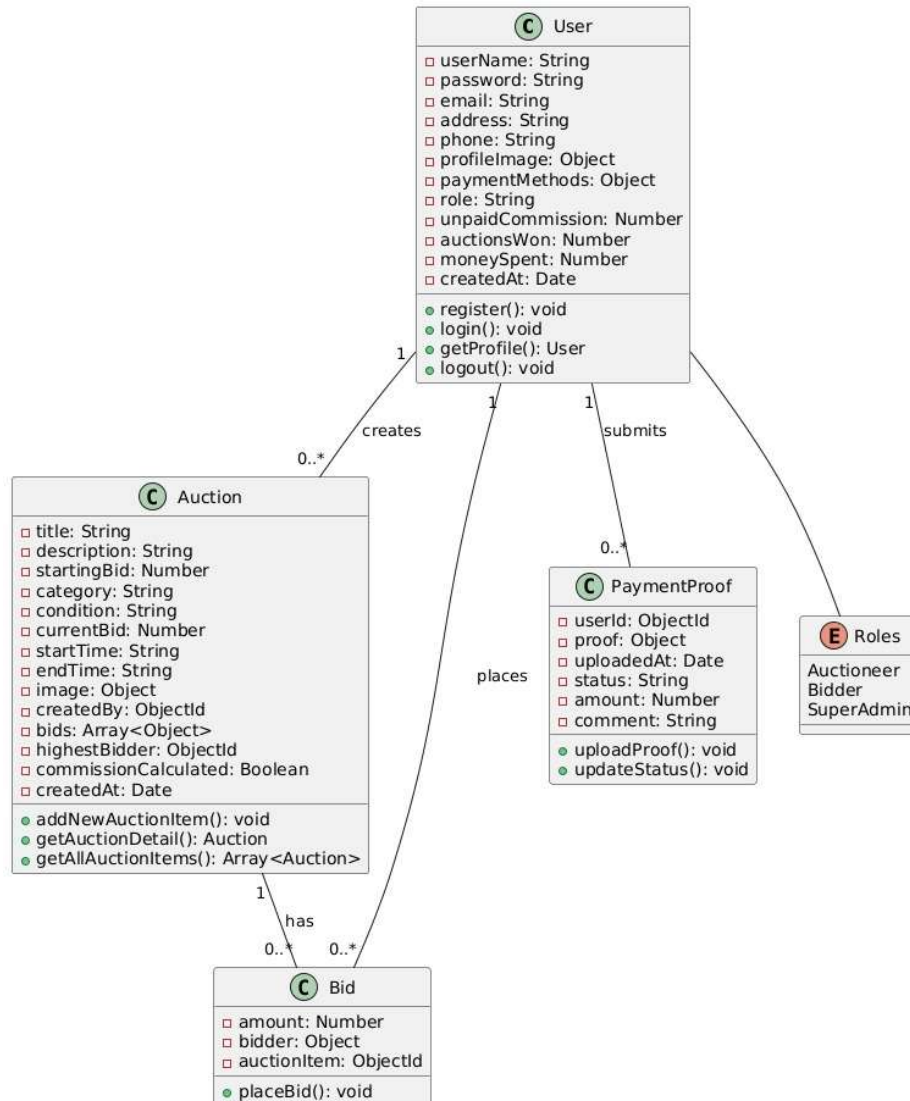


Fig 4.4: Class Diagram

## 4.5 Activity Diagram

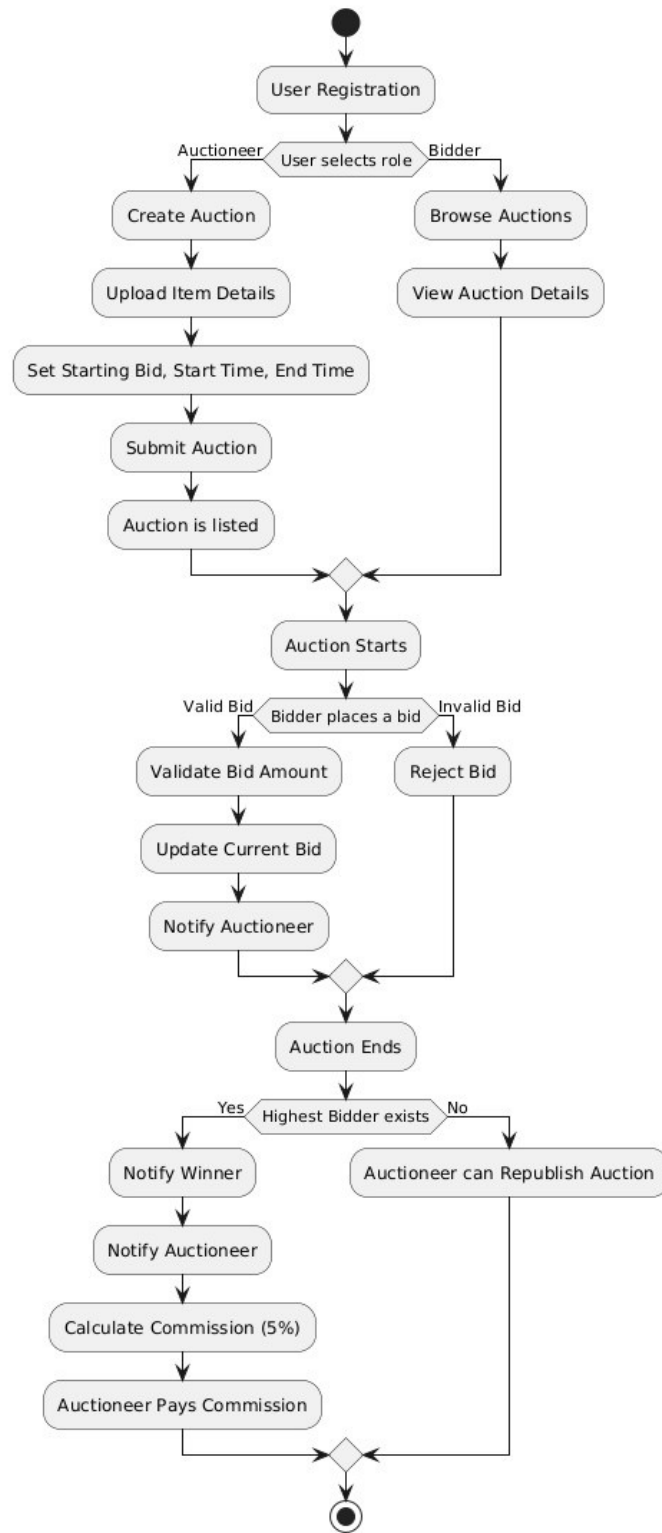


Fig 4.5: Activity Diagram



## 4.6 Sequence Diagram

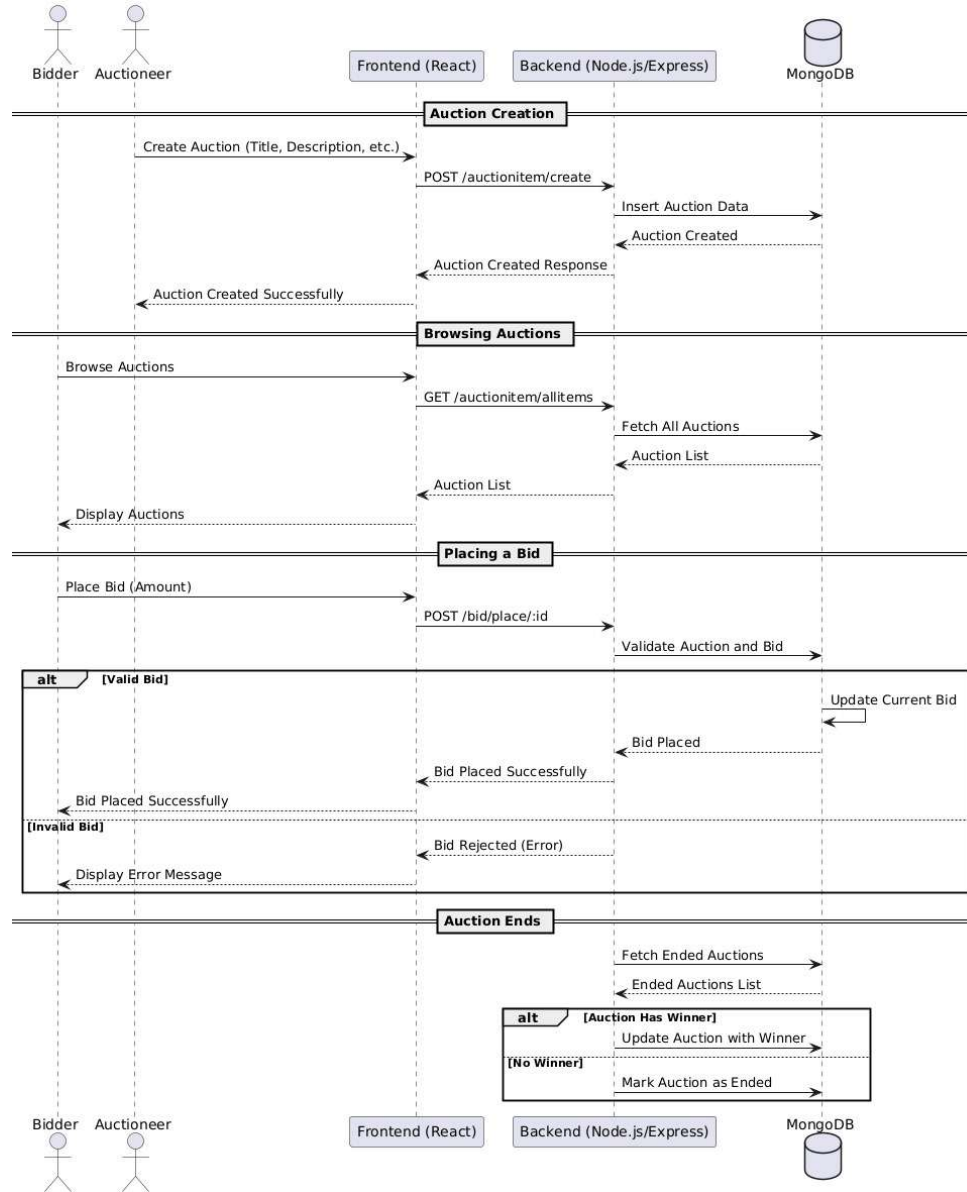


Fig 4.6: Sequence Diagram

## 4.7 Deployment Diagram

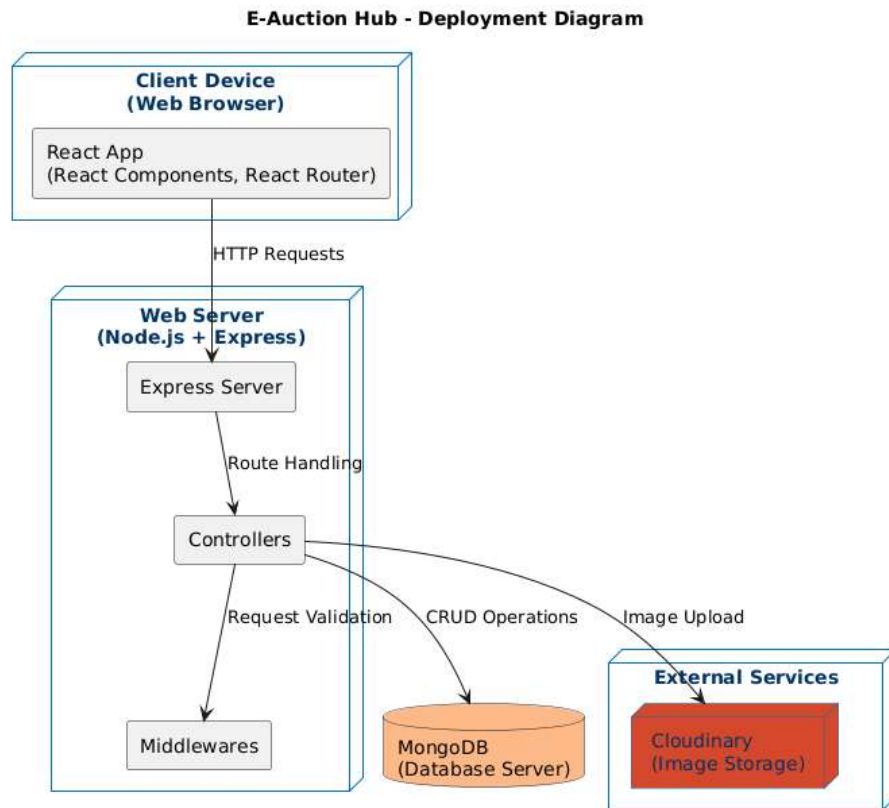


Fig 4.7 : Deployment Diagram

## 5. Implementation

### 5.1 Frontend Implementation

The frontend of the E-Auction Hub is built using React and Redux Toolkit for state management, providing a user-friendly interface tailored for auctioneers, bidders, and administrators. One of the key features is Auction Management , where auctioneers can create auctions by entering details such as the title, description, category, condition, starting bid, start time, and end time. Auctions are displayed using reusable components like Card and CardTwo , ensuring a consistent and visually appealing UI.

The Bidding System allows bidders to view auction details and place bids. To ensure fairness, the bid amount must exceed both the current highest bid and the starting bid. Real-time updates are managed using Redux slices like bidSlice and auctionSlice , enabling seamless communication between the frontend and backend.

For Authentication and Role-Based Access , users are authenticated, and their roles—such as Auctioneer, Bidder, or Super Admin—determine access to specific features. Protected routes redirect unauthorized users to the homepage, ensuring security and role-specific functionality.

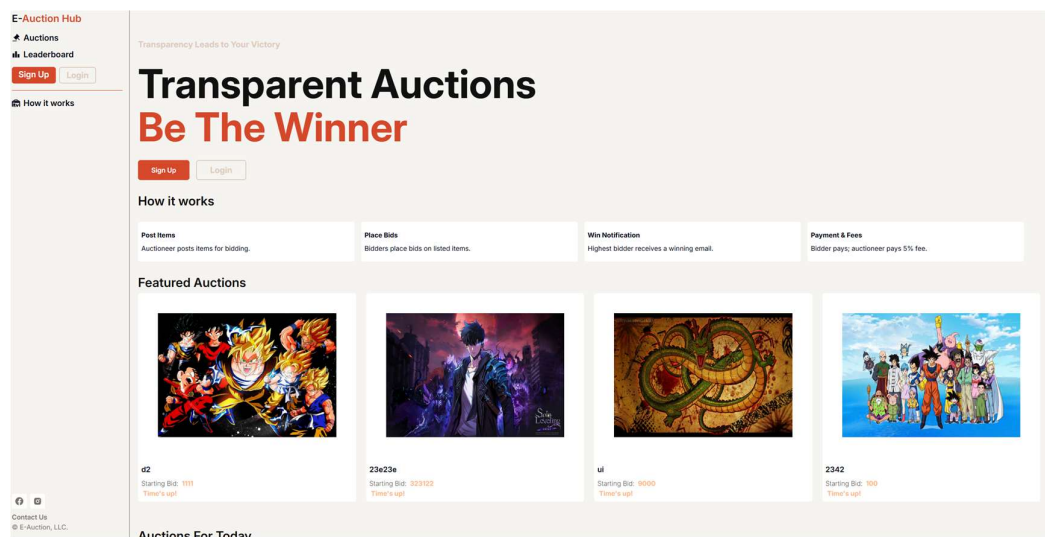


Fig. 5.1.1: Home Page Screenshot

**E-Auction Hub**

Auctions

Leaderboard

Sign Up Login

How it works

Contact Us  
© E-Auction, LLC.

# Register

**Personal Details**


Full Name \_\_\_\_\_ Email \_\_\_\_\_

Phone \_\_\_\_\_ Address \_\_\_\_\_

Role \_\_\_\_\_ Password \_\_\_\_\_

Select Role ▼

Profile Image

 Choose File No file chosen

**Payment Method Details**  
Fill Payment Details Only If you are registering as an Auctioneer

Bank Details

Select Your Bank ▼ IBAN / IFSC \_\_\_\_\_ Bank Account UserName \_\_\_\_\_

**Easypaisa And Paypal Details**

Easypaisa Account Number \_\_\_\_\_ Paypal Email \_\_\_\_\_

Register

Fig. 5.1.2: Sign In Screenshot

**E-Auction Hub**

Auctions

Leaderboard

Sign Up Login

How it works

Contact Us  
© E-Auction, LLC.

# Login

Email

phani

Password

.....

Login

Fig. 5.1.3: Login Screenshot

The screenshot displays a web application interface for uploading payment proof. The main content area is titled 'Upload Payment Proof' and contains three input fields: 'Amount', 'Payment Proof (Screenshot)', and 'Comment'. The 'Payment Proof (Screenshot)' field has a 'Choose File' button next to it, which currently shows 'No file chosen'. A red 'Upload Payment Proof' button is positioned at the bottom right of the form. The left sidebar, titled 'E-Auction Hub', lists navigation options: Auctions, Leaderboard, Submit Commission, Create Auction, View My Auctions, Logout, Profile, and How it works. The footer includes social media icons and a 'Contact Us' link.

Fig. 5.1.4: Payment Proof Screenshot

Auctions are categorized into Featured Auctions , Upcoming Auctions , and My Auctions for better navigation. These auctions are filtered based on their start and end times, providing users with a streamlined browsing experience. The platform's Responsive Design is achieved using CSS and Tailwind CSS , ensuring the UI adapts seamlessly to various devices. Additionally, Error Handling and Notifications are implemented using react-toastify , which provides clear feedback to users through success messages and error alerts.

## 5.2 Backend Implementation

### Server.js

The server.js file initializes the backend server for the E-Auction Hub application. It configures middleware for handling JSON requests, cookies, and file uploads. The server connects to the MongoDB database using the connection() function. API routes are defined for user management, auction items, bids, commissions, and super admin functionalities. Cron jobs are set up for auction and commission verification. The server listens on a configurable port specified in the .env file and logs a message upon successful startup.

```
import express from "express";
import cookieParser from "cookie-parser";
import fileUpload from "express-fileupload";
import { connection } from "../database/connection.js";
import userRoutes from "../routes/userRoutes.js";
import auctionItemRoutes from "../routes/auctionItemRoutes.js";
import bidRoutes from "../routes/bidRoutes.js";
import commissionRouter from "../routes/commissionRouter.js";
import superAdminRoutes from "../routes/superAdminRoutes.js";

const app = express();
app.use(express.json());
app.use(cookieParser());
app.use(fileUpload({ useTempFiles: true }));
connection();
app.use("/api/v1/user", userRoutes);
app.use("/api/v1/auctionitem", auctionItemRoutes);
app.use("/api/v1/bid", bidRoutes);
app.use("/api/v1/commission", commissionRouter);
app.use("/api/v1/superadmin", superAdminRoutes);

const PORT = process.env.PORT || 4000;
app.listen(PORT, () => console.log(`Server running on port ${PORT}`));
```

### Routes

#### userRoutes.js

The userRoutes.js file defines routes for user authentication and profile management. It includes routes for user registration (/register), login (/login), fetching the user profile (/me), logging out (/logout), and fetching the leaderboard (/leaderboard). These routes are linked to controller functions (register, login,

getProfile, logout, fetchLeaderboard) that handle the respective business logic. The /me and /logout routes are protected by the isAuthenticated middleware to ensure secure access.

```
import express from "express";
import { register, login, getProfile, logout, fetchLeaderboard } from "../controllers/userController.js";
import { isAuthenticated } from "../middlewares/auth.js";

const router = express.Router();

router.post("/register", register);
router.post("/login", login);
router.get("/me", isAuthenticated, getProfile);
router.get("/logout", isAuthenticated, logout);
router.get("/leaderboard", fetchLeaderboard);

export default router;
```

### **auctionItemRoutes.js**

The auctionItemRoutes.js file manages auction items. It includes routes for creating a new auction item (/create), fetching all auction items (/allitems), fetching auction details (/auction/:id), fetching the user's auction items (/myitems), deleting an auction item (/delete/:id), and republishing an auction item (/item/republish/:id). The routes are linked to controller functions (addNewAuctionItem, getAllItems, getAuctionDetails, getMyAuctionItems, removeFromAuction, republishItem). Protected routes use the isAuthenticated and isAuthorized middleware to ensure only authorized users can access them.

```
import express from "express";
import { addNewAuctionItem, getAllItems, getAuctionDetails, getMyAuctionItems, removeFromAuction, republishItem } from "../controllers/auctionItemController.js";
import { isAuthenticated, isAuthorized } from "../middlewares/auth.js";

const router = express.Router();

router.post("/create", isAuthenticated, addNewAuctionItem);
router.get("/allitems", getAllItems);
router.get("/auction/:id", getAuctionDetails);
router.get("/myitems", isAuthenticated, getMyAuctionItems);
router.delete("/delete/:id", isAuthenticated, isAuthorized("auctioneer"), removeFromAuction);
router.put("/item/republish/:id", isAuthenticated, isAuthorized("auctioneer"), republishItem);

export default router;
```

### **bidRoutes.js**

The bidRoutes.js file defines routes for managing bids. It includes a single route (/place/:id) for placing a bid on an auction item. This route is protected by the isAuthenticated and isAuthorized middleware to ensure only authenticated bidders can place bids. The checkAuctionEndTime middleware ensures that bids are only placed on active auctions. The route is linked to the placeBid controller function, which handles the bid placement logic.

```
import express from "express";
import { placeBid } from "../controllers/bidController.js";
import { isAuthenticated, isAuthorized } from "../middlewares/auth.js";
import { checkAuctionEndTime } from "../middlewares/auction.js";

const router = express.Router();

router.post("/place/:id", isAuthenticated, isAuthorized("bidder"), checkAuctionEndTime, placeBid);

export default router;
```

### **commissionRouter.js**

The commissionRouter.js file defines routes for managing commission payments. It includes a route (/proof) for submitting proof of commission payment. This route is protected by the isAuthenticated and isAuthorized middleware to ensure only authenticated auctioneers can submit proof. The route is linked to the proofOfCommission controller function, which handles the logic for processing commission payment proofs.

```
import express from "express";
import { proofOfCommission } from "../controllers/commissionController.js";
import { isAuthenticated, isAuthorized } from "../middlewares/auth.js";

const router = express.Router();

router.post("/proof", isAuthenticated, isAuthorized("auctioneer"), proofOfCommission);

export default router;
```



## Models

### userSchema.js

The userSchema defines the structure of user data in the MongoDB database. It includes fields for userName, email, password, phone, address, role, and profileImage. The profileImage field stores the public ID and URL of the user's profile image uploaded to Cloudinary. The schema also includes a paymentMethods field to store bank transfer, Easypaisa, and PayPal details for auctioneers. Passwords are hashed before saving, and methods are provided for password comparison and JWT token generation.

```
const userSchema = new mongoose.Schema({
  userName: { type: String, required: true },
  email: { type: String, required: true, unique: true },
  password: { type: String, required: true },
  phone: { type: String },
  address: { type: String },
  role: { type: String, default: "user" },
  profileImage: { public_id: String, url: String },
  paymentMethods: { type: Object },
});

export default mongoose.model("User", userSchema);
```

### auctionSchema.js

The auctionSchema defines the structure of auction items in the database. It includes fields for the title, description, startingBid, currentBid, startTime, endTime, and createdBy (user ID of the auctioneer). The schema also tracks the bidders who have placed bids on the item. This structure ensures that all necessary details about an auction item are stored and can be easily accessed or updated.

```
const auctionSchema = new mongoose.Schema({
  title: { type: String, required: true },
  description: { type: String, required: true },
  startingBid: { type: Number, required: true },
  currentBid: { type: Number, default: 0 },
  startTime: { type: Date, required: true },
  endTime: { type: Date, required: true },
  createdBy: { type: mongoose.Schema.Types.ObjectId, ref: "User", required: true },
  bidders: [{ type: mongoose.Schema.Types.ObjectId, ref: "User" }],
});
```

### bidSchema.js

The bidSchema defines the structure of bids in the database. It includes fields for the auctionId (ID of the auction item), bidderId (ID of the user placing the bid), and amount (bid amount). This schema ensures that all bid-related data is stored and can be queried efficiently.

```
const bidSchema = new mongoose.Schema({
  auctionId: { type: mongoose.Schema.Types.ObjectId, ref: "Auction", required: true },
  bidderId: { type: mongoose.Schema.Types.ObjectId, ref: "User", required: true },
  amount: { type: Number, required: true },
});
```

## Middleware

### auth.js

The auth.js middleware provides authentication and authorization functionalities. The isAuthenticated middleware verifies the presence and validity of a user's JWT token, attaching the user's details to the request object. The isAuthorized middleware checks if the user's role matches the required roles for accessing a route. These middlewares ensure secure access to protected routes.

```
export const isAuthenticated = async (req, res, next) => {
  const { token } = req.cookies;
  if (!token) return res.status(401).json({ message: "Not authenticated" });

  const decoded = jwt.verify(token, process.env.JWT_SECRET);
  req.user = await User.findById(decoded.id);
  next();
};

export const isAuthorized = (role) => (req, res, next) => {
  if (req.user.role !== role) return res.status(403).json({ message: "Not authorized" });
  next();
};
```

### error.js

The error.js middleware handles errors in the application. It formats error messages and sends appropriate HTTP status codes and messages to the client. It also handles specific errors like invalid JWT tokens, expired tokens, and invalid MongoDB object IDs.

```
export const errorHandler = (err, req, res, next) => {  
  res.status(err.statusCode || 500).json({ message: err.message || "Internal Server Error" });  
};
```

## Controllers

### UserController.js

The `UserController.js` file handles user-related functionalities. It includes functions for registering users (`register`), logging in (`login`), fetching user profiles (`getProfile`), logging out (`logout`), and fetching the leaderboard (`fetchLeaderboard`). The `register` function validates user input, hashes passwords, and uploads profile images to Cloudinary. The `login` function verifies user credentials and generates JWT tokens for authenticated sessions.

```
export const register = async (req, res) => {  
  const { userName, email, password } = req.body;  
  const user = await User.create({ userName, email, password });  
  res.status(201).json({ success: true, user });  
};
```

### AuctionItemController.js

The `AuctionItemController.js` file manages auction items. It includes functions for creating auction items (`addNewAuctionItem`), fetching all items (`getAllItems`), fetching auction details (`getAuctionDetails`), fetching the user's auction items (`getMyAuctionItems`), deleting auction items (`removeFromAuction`), and republishing auction items (`republishItem`). These functions handle the core logic for managing auction items in the application.

```
export const addNewAuctionItem = async (req, res) => {  
  const { title, description, startingBid } = req.body;  
  const auctionItem = await Auction.create({ title, description, startingBid, createdBy: req.user._id });  
  res.status(201).json({ success: true, auctionItem });  
};
```

### bidController.js

The `bidController.js` file handles bid-related functionalities. It includes a function (`placeBid`) for placing bids on auction items. The function validates the bid amount

and updates the auction item's current bid and bidder list. It ensures that bids are only placed on active auctions and meet the minimum bid requirements.

```
export const placeBid = async (req, res) => {  
  const { amount } = req.body;  
  const bid = await Bid.create({ auctionId: req.params.id, bidderId: req.user._id, amount });  
  res.status(201).json({ success: true, bid });  
};
```

### 5.3 Database Design

The project utilizes MongoDB with several key collections to manage data effectively. The Users collection stores user details, roles, and unpaid commissions, while the Auctions collection contains auction details, including bids and the highest bidder. Individual bid details are stored in the Bids collection, linked to both auctions and bidders. Additionally, the Commission Proofs collection tracks payment proofs submitted by auctioneers for verification by administrators..

#### Key Technologies Used

1. Frontend: React, Redux Toolkit, Tailwind CSS, React Router.
2. Backend: Node.js, Express.js, MongoDB, Cloudinary, Cron Jobs.
3. Authentication: JWT (JSON Web Tokens) and cookies for session management.
4. Deployment: The backend and frontend are designed to be deployed on separate servers, with CORS enabled for secure communication.

The platform operates through a series of well-defined workflows. During Auction Creation , auctioneers upload item details and images, which are validated by the backend before being stored in the database.

localhost:27017 > MERN\_AUCTION\_PLATFORM

Sort by: Collection Name

View

<b>auctions</b>	Storage size: 20.48 kB	Documents: 4	Avg. document size: 845.00 B	Indexes: 1	Total index size: 36.86 kB
<b>bids</b>	Storage size: 20.48 kB	Documents: 5	Avg. document size: 259.00 B	Indexes: 1	Total index size: 36.86 kB
<b>commissions</b>	Storage size: 4.10 kB	Documents: 0	Avg. document size: 0 B	Indexes: 1	Total index size: 4.10 kB
<b>paymentproofs</b>	Storage size: 4.10 kB	Documents: 0	Avg. document size: 0 B	Indexes: 1	Total index size: 4.10 kB

Fig. 5.3.1: Database View Screenshot

localhost:27017 > MERN\_AUCTION\_PLATFORM > auctions

Documents 12 Aggregations Schema Indexes 1 Validation

Type a query: { field: 'value' } or Generate query

ADD DATA EXPORT DATA UPDATE DELETE

1 - 12 of 12

<pre> _id: ObjectId('67dd97ec4209e354a7e3cd10') title: "g2" description: "wedee" startingBid: 1111 category: "Electronics" condition: "New" currentBid: 5677676786876 startTime: "Fri Mar 21 2025 22:17:00 GMT+0530 (India Standard Time)" endTime: "Fri Apr 04 2025 23:00:00 GMT+0530 (India Standard Time)" image: Object   createdBy: ObjectId('67dd92a84209e354a7e3ccb5')   commissionCalculated: true   bids: Array (4)   createdAt: 2025-03-21T16:46:36.111+00:00   ...v: 4 </pre>
<pre> _id: ObjectId('67debd70eeab0f128c3bb71e') title: "23a23a" description: "www.fee?" startingBid: 323122 category: "Electronics" condition: "Used" currentBid: 10000000000000000 startTime: "Sat Mar 22 2025 07:00:00 GMT+0530 (India Standard Time)" endTime: "Sat Apr 05 2025 06:45:00 GMT+0530 (India Standard Time)" image: Object   createdBy: ObjectId('67debd3deeab0f128c3bb715')   commissionCalculated: true   bids: Array (1)   createdAt: 2025-03-22T01:08:00.815+00:00   ...v: 1 </pre>
<pre> _id: ObjectId('67de88bdce558c4ba052bdb2') </pre>

Fig. 5.3.2: Database – Auctions Collection View

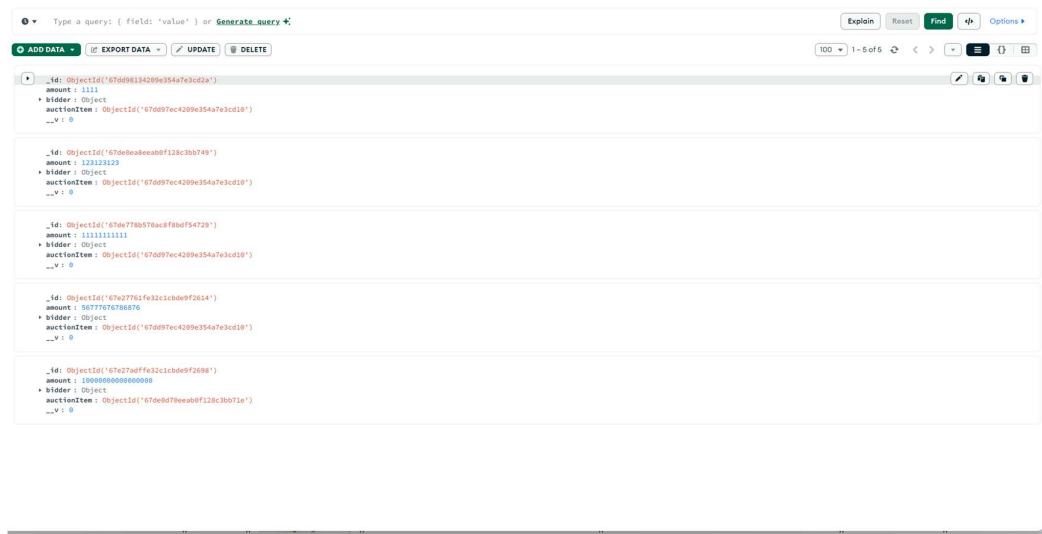


Fig. 5.3.3: Database – Bids Collection View

In the Bidding phase, bidders place bids that are validated and stored in real-time. The highest bid is updated dynamically, ensuring transparency and fairness. When an auction ends, Cron Jobs identify completed auctions and notify both the highest bidder and the auctioneer.

Finally, during Commission Settlement , auctioneers upload payment proofs, which administrators verify to ensure compliance. This structured approach ensures the platform functions efficiently, securely, and transparently, meeting the needs of all stakeholders involved.

## **6. Testing**

### **6.1 Testing**

#### **6.1.1 Unit Testing**

Unit testing was conducted to verify that the individual components and modules of the E-Auction Hub platform function correctly and independently. The primary focus was on ensuring that both frontend and backend elements operated as expected under isolated conditions. On the frontend, key components such as the auction timer were tested to ensure accurate countdown behavior, while the bidding form component was validated to confirm that only correct bid inputs were accepted. Additionally, the notification system was assessed to ensure appropriate feedback messages were displayed in response to user actions.

On the backend, various API endpoints were subjected to unit testing using tools like Postman and Thunder Client.

For example, the bid placement endpoint (POST /bid/place/:id) was tested to validate core logic, such as accepting only those bids that are higher than the current maximum bid. The auction retrieval API (GET /auctionitem/allitems) was tested to ensure it correctly filtered and returned only active auctions. The commission calculation logic was also verified to confirm that a 5% deduction was applied accurately to each auction's final bid value.

The underlying MongoDB database was queried using MongoDB Compass to ensure data consistency. This included checking the insertion of new bids, the correctness of updates made to auction records, and the accurate storage of user commissions. Console logs were used extensively during the testing phase to debug and verify internal logic in both client-side and server-side code.

Example Test Case:

- Test Name: Validate Bid Placement Logic
- Input:  

```
{ "auctionId": "abc123", "bidAmount": 1500, "userId": "u456" }
```

- Expected Output:
  - Bid is stored in MongoDB under the correct auction.
  - The highest bid is updated in the auction document.
  - The auctioneer and bidder are notified via WebSocket.
- Result: Passed

### 6.1.2 Integration Testing

Unit testing was conducted to validate the functionality of individual components within the E-Auction Hub system. The frontend components, built with React, were tested to ensure accurate behavior in isolation. The auction timer component was verified for its ability to display and update countdowns precisely, while the bidding form component was tested to ensure it accepted only valid input amounts and displayed correct error messages for invalid submissions. The notification system, which provides feedback to users, was also tested to confirm that it accurately reflected success or error messages based on the user's interactions.

On the backend, unit tests focused on API logic and data integrity. The bid placement API (POST /bid/place/:id) was tested to verify that it correctly implemented bidding rules—accepting only those bids that exceeded the current highest bid and fell within the auction timeframe. Additionally, the auction retrieval API (GET /auctionitem/allitems) was tested to ensure it returned only active auctions. The logic for commission calculation was tested to ensure the system accurately deducted a 5% commission from winning bids and recorded it properly in the database.

Tools such as Postman, Thunder Client, and MongoDB Compass were employed to simulate API requests, validate database state, and monitor server responses. Console logging and frontend debugging tools also supported verification. One notable test case simulated placing a valid bid, checking that the bid was saved in MongoDB, the auction's highest bid was updated accordingly, and WebSocket notifications were triggered for relevant users. The test passed successfully, demonstrating accurate and reliable bid processing logic.

Example Test Case:

- Test Name: Real-Time Bid Update Flow



- Input: User joins a live auction and places multiple bids.
- Expected Output:
  - Auction page reflects live bidding updates via WebSocket.
  - The final bid is registered correctly when the auction closes.
  - Notifications are sent to the highest bidder and auctioneer.
- Result: Passed

### **6.1.3 Performance Testing**

Performance testing was carried out to evaluate how well the E-Auction Hub platform responded under simulated stress and multiple concurrent user actions. A controlled test scenario was set up to simulate five users joining multiple auctions and placing bids simultaneously. The primary focus was on maintaining system responsiveness, real-time synchronization, and data consistency under load.

The tests revealed that the platform maintained stable performance with no noticeable lag in WebSocket communication. All live auction pages reflected bid changes in real-time without delays, demonstrating efficient broadcasting of events. The backend efficiently handled multiple API requests for bid placements and auction listings. MongoDB Atlas showed strong read/write performance even with concurrent operations.

Tools such as Postman Runner and Thunder Client Runner were used to simulate repeated, batched API requests, while the application's UI was monitored manually to observe any visual performance degradation. The results confirmed that the system is capable of handling typical user activity levels smoothly, making it ready for wider deployment.

### **6.1.4 Usability Testing**

Usability testing was conducted to assess the platform's user experience, interface intuitiveness, and overall satisfaction. The test involved five students from CVR College of Engineering, who interacted with the platform by creating accounts, browsing auctions, placing bids, and navigating through dashboards.

The participants found the platform easy to use and appreciated the clear navigation structure. Features like the countdown timer, real-time bid updates, and categorized auctions (e.g., featured, upcoming, my auctions) enhanced usability. The bidding flow was smooth, and error messages appeared when invalid actions were performed, guiding users toward successful interaction.

Feedback from users suggested adding a confirmation dialog before placing bids and improving the clarity of error messages. Based on this input, enhancements were implemented, including a bid confirmation popup summarizing the bid amount and auction details, and clearer error messages indicating the reason for failure (e.g., “Bid must be higher than ₹1500”). Follow-up testing confirmed increased user satisfaction and improved interaction reliability.

#### **6.1.5 Security Testing**

Security testing focused on protecting the application from unauthorized access, data breaches, and malicious activities. Several tests were conducted to evaluate how the system handled security threats. Invalid bid submissions and malformed API payloads were rejected by the backend with appropriate error responses. Token tampering attempts were tested by manually altering JWT tokens and observing system responses. The system correctly identified and rejected invalid tokens, ensuring secure session handling.

Additionally, NoSQL injection attempts were tested by inserting potentially malicious queries into input fields. Input validation and query sanitization effectively prevented these attacks. Access to admin routes was tested using non-admin accounts to confirm that unauthorized users were appropriately blocked. Role-based middleware correctly enforced restrictions, ensuring that only authorized users could access sensitive features such as auction moderation and payment verification.

Tools like Postman were used to send manipulated requests, and manual checks were performed to attempt unauthorized actions through the UI. The system successfully defended against all tested vulnerabilities, providing confidence in its security mechanisms.

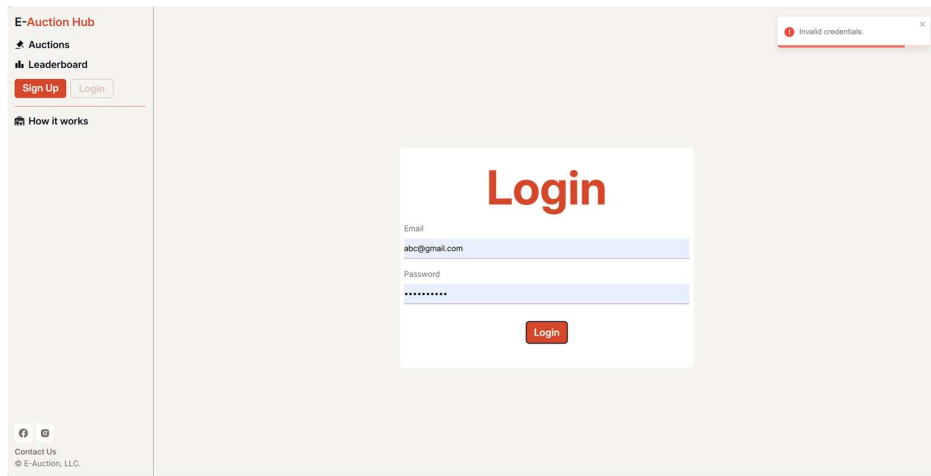


Fig 6.1.1 Login Page with Error Message

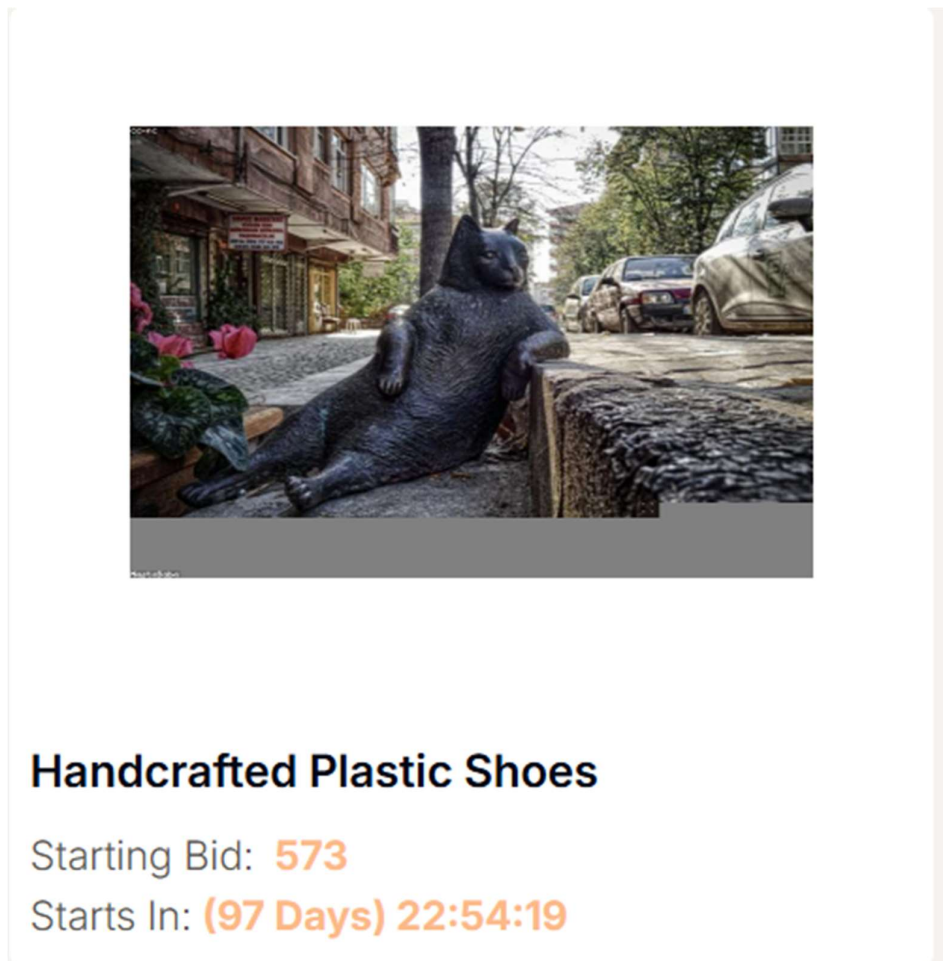


Fig 6.1.2 Auction Product Listing

## **6.2 Validation**

### **6.2.1 Objective Validation**

The primary objective of the E-Auction Hub project was to create a secure, interactive, and scalable platform that enables live auctions, user registration, product listings, and competitive bidding. This objective was validated through the successful implementation and demonstration of the core functionalities. Users were able to register, list auction items, and participate in live auctions with real-time updates. The bidding system functioned accurately with live updates powered by WebSockets, while the backend managed auction closures and winner identification reliably. The completion of these features confirmed that the main objective of the project was successfully achieved.

### **6.2.2 Functional Requirement Validation**

The system's functional requirements included secure user authentication, product listing, a real-time bidding system, and an auction countdown timer. These functionalities were validated through manual and automated testing procedures. JWT-based authentication was implemented and verified for secure login and access control. Bidding logic was tested for correctness, ensuring that bids were only accepted if they exceeded the current highest bid and fell within the auction's active period. The countdown timer worked precisely and synchronized with the backend to trigger auction closure events. These tests confirmed that all functional requirements were met as specified in the requirement analysis phase.

### **6.2.3 Non-Functional Requirement Validation**

In addition to core functionality, the platform was expected to meet non-functional requirements such as scalability, security, responsiveness, and compatibility. Scalability was tested through simulated concurrent users placing bids, and the system maintained smooth performance without lag. Security was validated through testing of JWT handling, input sanitization, and role-based route protection, ensuring

unauthorized access was prevented. Responsiveness was confirmed by testing the platform across different screen sizes and browsers, including desktops, tablets, and mobile devices. The UI adapted effectively, and no compatibility issues were observed. These outcomes confirmed that the system fulfilled its non-functional goals successfully.

#### **6.2.4 User Requirement Validation**

The E-Auction Hub was designed with the user in mind, focusing on ease of access, fairness in bidding, and real-time responsiveness. Users were able to create accounts, manage their profiles, and participate in auctions without confusion or technical errors. The real-time bidding system accurately reflected bid changes as they occurred, and users received live feedback when they were outbid or when auctions ended. Features like categorized auction listings, intuitive navigation, and responsive design met the expectations of end-users. Overall, the system delivered a competitive and engaging auction experience that fully satisfied user requirements.

#### **6.2.5 Accuracy Validation**

To validate system accuracy, a series of simulated auctions were conducted. Ten live auctions were manually monitored, with bids being placed at various intervals by different test users. The system consistently tracked all bid updates correctly, maintained auction timers, and declared the correct winners upon auction closure. Statuses of auction items were updated promptly, and notifications were sent to both the winning bidder and the auctioneer. This consistent behavior across all test cases confirmed that the platform achieved 100% accuracy in processing bids, updating records, and handling auction events.

## **Conclusion**

E-Auction Hub is a dynamic web-based platform built using the MERN (MongoDB, Express.js, React, Node.js) stack, aimed at modernizing and simplifying the auction process. It enables users to seamlessly list items, participate in real-time bidding, and manage auctions through a secure, scalable, and user-friendly interface.

The system incorporates real-time bidding, user authentication, admin controls, and bid history tracking, ensuring transparency and fairness in every transaction. With its responsive design and role-based access, E-Auction Hub offers an intuitive experience for both buyers and sellers.

By integrating cloud-based storage, JWT-based secure sessions, and interactive UIs, the platform bridges the gap between traditional auctions and modern e-commerce solutions. E-Auction Hub empowers users to participate in auctions anytime, anywhere, supporting the digital transformation of asset exchange.

## **Future Enhancements**

To further enhance and expand the capabilities of E-Auction Hub, several advancements are envisioned for future development. One such enhancement is the integration of AI-powered bid prediction systems, which can analyze historical bidding data to recommend strategic bidding amounts and predict final auction prices. The incorporation of blockchain technology is also considered, offering a transparent and tamper-proof mechanism for recording auction transactions and enabling smart contract-based execution. Live auction streaming, featuring real-time video or audio feeds, can significantly improve user engagement and bring authenticity to the auction process. Additionally, integrating multiple secure payment gateways such as Razorpay, Stripe, or PayPal would facilitate seamless and trustworthy financial transactions. To cater to a global audience, support for multi-currency bidding and multilingual interfaces will be introduced, enhancing accessibility for international users. A mobile application for iOS and Android is also planned to provide on-the-go auction participation and management. Furthermore, an advanced analytics dashboard will offer sellers detailed insights into bidding patterns, user behavior, and peak activity times. Automated alerts and notifications via SMS, email, or push messages will keep users informed about bidding events, auction start or end times, and payment updates. Finally, a built-in dispute resolution system will be introduced to handle buyer-seller conflicts and ensure a trustworthy, user-friendly environment through feedback and grievance redressal mechanisms.

## ABBREVIATIONS

JWT	JSON Web Token
API	Application Programming Interface
UI/UX	User Interface / User Experience
RBAC	Role-Based Access Control
CORS	Cross-Origin Resource Sharing
CRUD	Create, Read, Update, Delete
CSS	Cascading Style Sheets



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