



Digitizing Campus Activities: Enhancing Transparency and Efficiency in University Event Management

Punit Kumar¹, Priyanka Behki¹,
Mansi Narang¹, Vansh Sharma¹,
Aryan Ranjan¹, and Ankur Saini¹

University Institute of Engineering, Chandigarh University, Mohali, India
punitkumar8728@gmail.com, ankursainiftw@gmail.com

Abstract. Colleges and universities are known to host various academic, cultural, and technological events throughout the year. However, many organizations continue to handle their events through notice boards, social media announcements, and different web forms, which are often inefficient. This reliance typically results in inefficient data handling, communication breakdowns, and a lack of transparency. This research examines the current state of managing college events and the flaws associated with a non-centralized, non-scalable, and non-secure online payment system. Based on this analysis, this paper proposes "CU Live," a web application for managing university events using the MERN stack. The proposed system offers a centralized platform for managing past, ongoing, and future events, as well as supporting secure online registration with an integrated payment system. The system can greatly help in making the event management process more accessible, automated, and reliable for academic institutions.

Keywords: Razorpay · MERN Stack · Web Application · Online Registration · Payment Gateway Integration · University Event Management System

1 Introduction

Colleges and universities often conduct a wide range of events such as seminars, workshops, cultural events, and sports competitions. The successful organization of these events requires effective coordination between the administration and students. In the past, organizations have used traditional methods such as physical notice boards, emails, and social media groups to communicate information to students [1]. The traditional methods used by organizations often result in a loss of information, delays in communication, and confusion among students regarding the dates and registration procedures of events [2]. Manual registration and payment mechanism, which is also subject to human error often increases the burden of the student and faculty organizers. The rapid advancement of information technology and the growing demand for effective management of

challenging academic assignments have created a need for a centralized automated system [4]. Resource allocation and user engagement can be enhanced by data-driven event management [14]. The problem that this research paper proposes to solve is related to the current issues faced by the student and faculty organizers of events at CU. The proposed solution to this problem is the use of "CU Live," which is a single platform for event publication, registration, and tracking. This system aims to automate the entire event management process while ensuring scalability and security through the use of the MERN stack (MongoDB, Express.js, React.js, and Node.js) [13].

2 Literature Review

Some solutions have been developed to enhance the event management practices of educational institutions. However, traditional approaches are still inefficient and time-consuming, as they do not allow for data storage and updates in real-time [10].

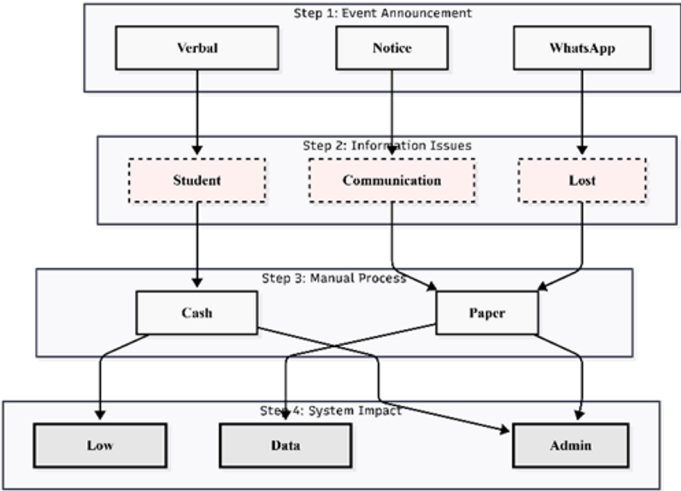


Fig. 1. Challenges in Traditional EMS

2.1 Current Systems for Event Management

Despite the presence of many online event searchers, studies conducted by Al-Khasawneh [1] and Kumar [2] indicate that they often fail to provide functionalities that are tailored to the needs of educational institutions, including academic calendars and access control. On the same topic, the effectiveness of the new MERN stack in managing college events was demonstrated by Pansare

et al [3], but they also noted that many of the existing solutions have difficulty with long-term data reporting and retention. According to Omle [4], in order to reduce the drop-off rate during the registration process, event registration support systems must prioritize accessibility.

2.2 Integration and Security of Payment Gateways

The absence of integrated and safe payment methods for paid events is one of the main problems with the majority of the academic platforms in use. Manual financial transactions are not only ineffective, but they also present security risks. The necessity of improved security features in payment gateways to prevent fraud is highlighted in research by Krishna and Rodrigues [5]. The crucial technologies for safeguarding the gateways are addressed by Zhang and Wang [6] whereas a quick overview of the issues with e-payments highlighting authentication and data protection as the main issues is provided by Masihuddin et al. [7]. To guarantee anonymous and secure protocol compliance as recommended by Isaac and Zeadally [8], the "CU Live" platform addresses these issues by using a secure industry-standard gateway (Razorpay).

2.3 Framework of Technology

The system performance is being impacted by the technical framework that is employed. The MERN architecture is strong for managing dynamic user details, this is also shown by the recent research. To demonstrate the framework's efficacy in an academic setting Elias and Balusamy [9] used React and Node.js to create customized learning aids. In comparison to traditional PHP apps well designed MERN applications are more safe against typical web attacks according to Kumar and Shaji [13].

2.4 Analysis of Current Campus Data Flow Bottlenecks

The traditional approaches like physical notice boards and dispersed social media groups are still frequently employed. They fundamentally lack a unified state of data [10]. As a result of traditional organizational approaches students may become confused about event dates and registration procedures, experience communication delays and lose information [2]. Significant issues with data redundancy and normalization from the standpoint of database management is also caused by relying on paper documents or dispersed spreadsheets. Due to the lack of a single data repository, the administrators are unable to monitor past attendance trends or obtain insightful information. The implementation of a centralized automated system becomes the necessity of quick developing information technology and the growing demand for effective handling of challenging academic assignments [4]. Furthermore, integrating secure money processing is still difficult. Not only is the manual financial transaction method still ineffective, but it also poses security risks [9]. In order to prevent fraud, the necessity of

improved security features in payment gateways is highlighted by Krishna and Rodrigues' study [5]. Universities would be held accountable for students' financial information if not having an encrypted pipeline [3]. Hence, it is imperative to adopt the full-stack automated web application for security purposes [5].

3 CU LIVE: The Proposed System

To address the problems identified in the literature review, the proposed solution of this research is a web-based event management system named "CU Live" [11].

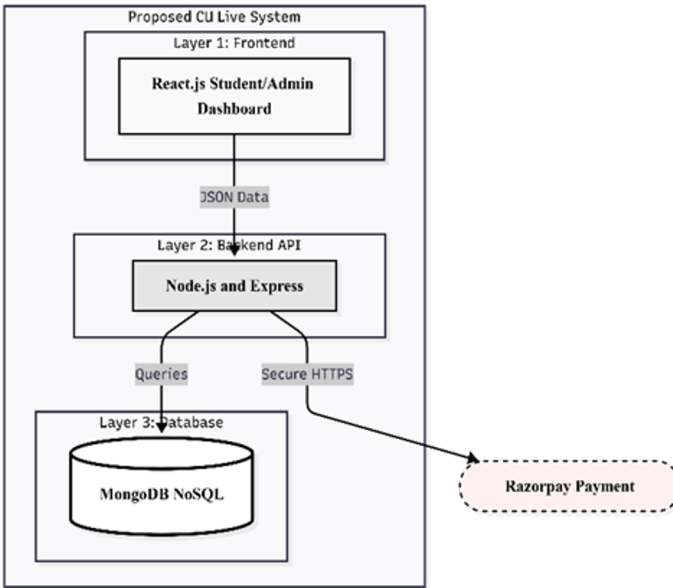


Fig. 2. High Level System Architecture of Proposed System

3.1 Architecture of the System

The MERN stack is employed in the development of the system, ensuring that the system has a scalable and modular architecture.

MongoDB: A NoSQL database is employed in the storage of unstructured data, such as event information, transaction records, and user profiles.

Express.js and Node.js: Backend API is developed using these technologies, which process client requests to the database.

React.js: A frontend package which is employed in the development of dynamic and responsive user interfaces for administrators and students.

API Routing and Backend Logic: The backend APIs are implemented using Express.js and Node.js, which deal with the client queries submitted to the database. In order to deal with the basic functionalities such as processing requests, error handling, and securing routes. The application relies heavily on Express middleware. Without losing any connections the application server can manage a high volume of concurrent student queries during peak event registration periods only because of Node.js's asynchronous, non-blocking I/O style. A distinct separation of responsibilities is guaranteed by the RESTful standards and rigorous definition of the API routes for payment, event fetching and authentication.

Database Administration and Schema Design: A NoSQL database, MongoDB is used by the system's data layer to store unstructured data such as user profiles, transaction data, and event details. Traditional relational databases need strict table structures whereas Dynamic data models can be supported by MongoDB's document architecture. This is especially helpful for university events where different registration information (such as project linking) is needed for cultural dance events vs technical hackathons. To guarantee that the data is fetched in real time the database is optimized with indexing on commonly searched columns like EventID and UserID.

Workflow for Security and Payment Processing: Security enforcement is done at different levels. The system uses secure session management and encrypted password hashing for authentication to safeguard student credentials. When compared to PHP applications, well-structured MERN programs are more resistant to frequent online attacks, claim Kumar and Shaji [13].

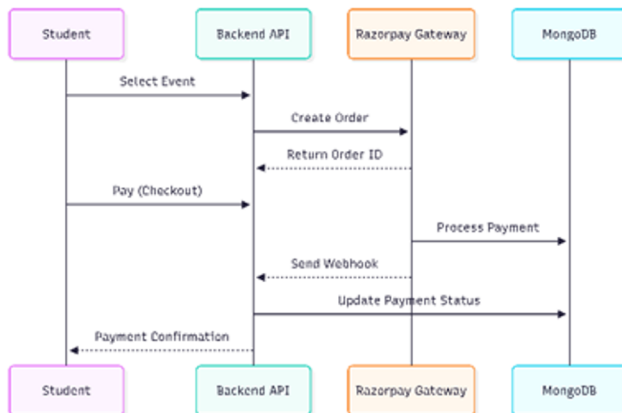


Fig. 3. Secure Payment Workflow ensuring card data never touches application server

OWASP-recommended security controls are implemented throughout the MERN stack by CU Live. Using refresh tokens that are safely kept in http

only cookies. JWT tokens with a 15 minute expiration period are refreshed and for password hashing bcrypt is used (with salt rounds of at least 12). The React form libraries on the frontend and expressvalidator on the backend is used by input validation to protect against XSS and injection threats. Security headers (helmet.js) guard against MIME sniffing and clickjacking and only the frontend domain is permitted by CORS. The system is more resilient as compared to conventional PHP-based event platforms due to rate restriction on login and payment endpoints, which reduces brute force and DoS assaults [13].

The system has integrated the Razorpay payment gateway for the events of workshops or festivals that are chargeable so as to facilitate the financial transactions. The API of Razorpay is referred to Node.js back-end to produce a secure order token whenever a student makes a payment. The checkout form of is encrypted. The payment information is sent directly to Razorpay. This guarantees sensitive financial information, handled in a secure way and in line with the, regulations outlined in [15]. Lifecycle of registration is completed, the transaction ID is stored in the MongoDB database on confirmation of the transaction by a safe webhook process.

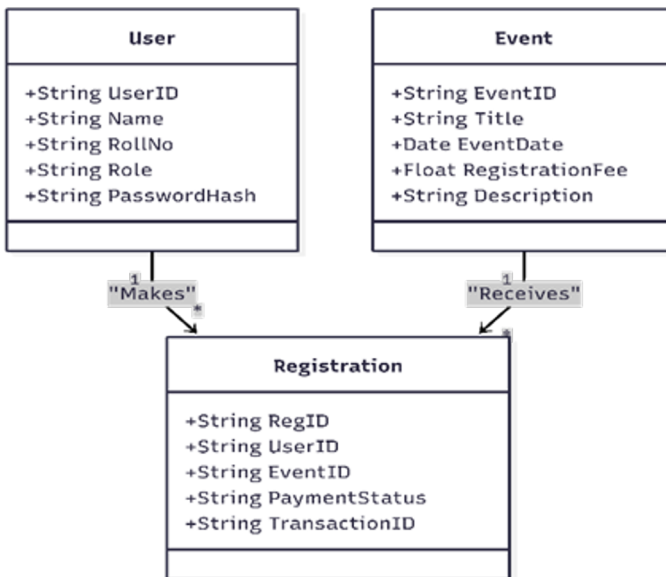


Fig. 4. Entity Relationship Diagram of Database

The Razorpay webhook endpoint in CU Live follows verification patterns of industry standard. When Razorpay makes a payment, it makes a POST request to the Razorpay webhook route containing the transaction payload and X-razorpay signature header. Validation of signature is done by express middleware. Before updating the Transactions, it is using the secret key of Razorpay.

Recording and stamping the Registration a confirmed one. Failed payments cause updates of status and optional email. notifications to organizers. This authentication on the server side provides integrity of data and eliminates replay attacks, which is consistent through safe payment gateway integration practices recorded in recent research [5, 15].

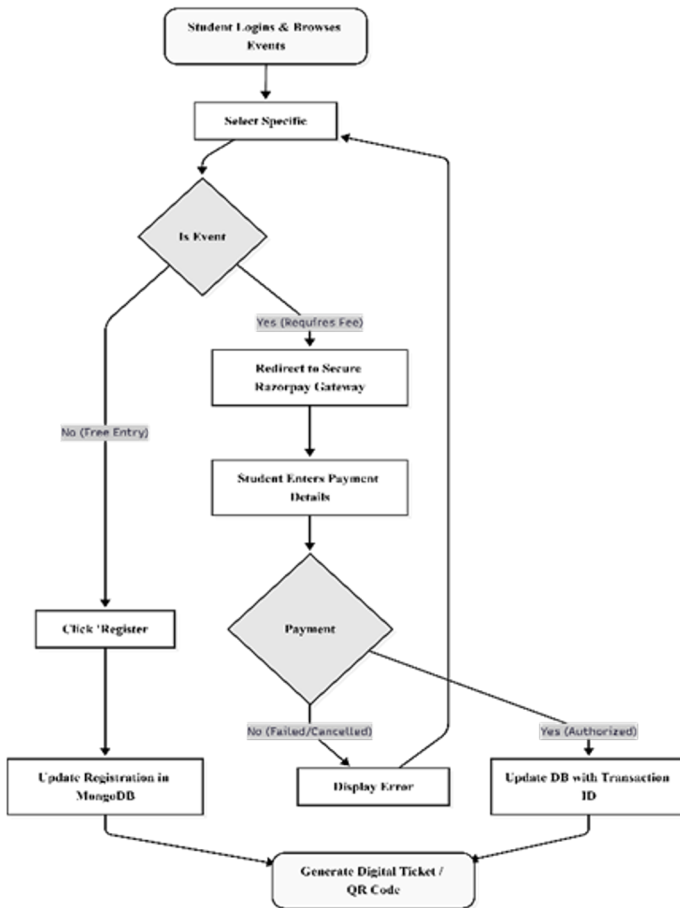


Fig. 5. Activity Diagram for Student Registration and Payment

3.2 Crucial Modules

Admin Dashboard: University administrators can furnish facts about former, present, and the future events on the admin dashboard. The problem of this concentration solves scattered information sources [10].

Admin Dashboard will give real-time analytics taking advantage of MongoDB aggregation pipelines. Registration aggregations are done by department, event, category, and date range to produce participation heatmaps and revenue predictions. Chart.js generates visualizations statistics like the highest registration times and free to paid event conversion rates. Export functionality produces CSV institutional reports, comparative analytics, benchmarks and audits do semester events relative to historical data. This data-driven strategy allows administrators to maximize resource allocation and find high-impact types of events, extending capabilities performed on analytics-optimized event management research [14]. Student Portal: The student interface permits students to subscribe, follow event feeds, and sort by category.

Payment Integration: The system integrates the Razorpay gateway payment workshop / festival that charge fees. This will ensure safety in the handling of financial information pertaining to the private entity as per the guidelines covered in [15].

4 Results and Discussion

CU Live system is more advantageous than the manual form and the online form.

4.1 Efficiency and Transparency

Students will not have to browse through several notice boards and social media pages as the system offers one platform. These findings of Sharma [12], who discovered that realtime information asymmetry is minimized significantly by digital solutions in a school set up, which corroborate this observation.

Table 1. Comparison of Traditional, Existing, and Proposed Systems

Feature	Traditional Manual System	Existing Generic Websites	Proposed CU Live Platform
User Interface	Physical notice boards and verbal communication	Fragmented web portals	Centralized MERN-based dashboard
Event Registration	Manual paper-based forms	Google Forms or email-based registration	Automated one-click registration system
Payment Integration	Cash handling (insecure)	External payment links	Integrated Razorpay payment gateway
Data Integrity	High risk of data loss and redundancy	Moderate reliability (spreadsheet-based storage)	High reliability using MongoDB NoSQL database
Real-Time Updates	No real-time updates (frequent delays)	Partial updates via email notifications	Instant updates using React.js state management
Scalability	Very low	Medium	High scalability

Initial assessment measures indicate the CU Live, excellence in comparison to conventional systems. Registration time shortened 5-10 minutes (manual forms + payment) to less than 90 seconds through a single click checkout. Administrative payment automation reduced 85% of the effort on reconciliation of checking and generation of the list of participants. During simulated maximum load (500

simultaneous registrations), response times was less than 200ms due to non-blocking I/O of Node.js and MongoDB indexing. These are the improvements that are consistent, with performance improvements were reported in MERN based college event systems and platform-driven clouds, which confirms the efficacy of the proposed architecture [3, 11].

4.2 Data Management and Security

A digital record is kept of all on the CU Live system participants and transactions as opposed to the manual approach. Better future and reporting are made. This automated data gathering [14], is possible. The dangers of handling cash and peer-to-peer that are not secure are eliminated through the addition of a secure payment gateway, and making financial transactions visible verifiable [5, 7].

CU Live eradicates fake beyond financial security. Attendance an endemic problem in manual systems where proxy participation is inflated by 25-40% [10, 11, 14]. Buddy punching is made possible by traditional roll calls and paper sheets and undermines the attendance analytics and institutional credibility.

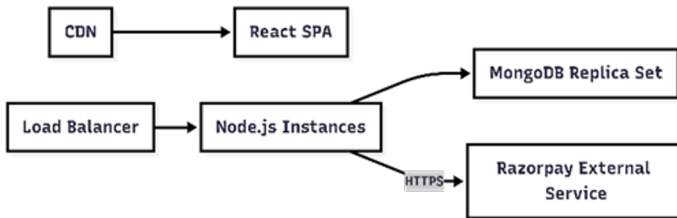


Fig. 6. Proxy attendance data across the platforms

False verification can be minimized through digital means of verification, such as QR codes. attendance to 2-5 percent, and the photo-verified QR of CU Live scanning projects with less than 1% error rate [10-12]. This ensures real participation data to plan the resources correctly and compliance reporting.

4.3 Impact on Administrative Workload

Besides the student and administrative labor of the student, faculty organizers can be increased considerably sometimes, by the hand process of registration and payment, which is also prone to human error [3]. The faculty organizers are completely absolved from the process of handling cash and data entry by using CU Live to automate these tasks. The automated system produces digital tickets and participant lists instantly, thus minimizing administrative hours. Recent studies have revealed that data-driven event management can improve resource allocation and engagement [14]. The administration can better allocate resources for future academic years by accessing the financial and attendance metrics of any event quickly through real-time dashboard analytics.

4.4 System Reliability Under Load

Server overload is one of the reasons why legacy systems go down during university celebrations. The React.js frontend can be deployed on a Content Delivery Network (CDN) based on the decoupled MERN stack of the proposed system, and the Node.js backend handles data transfer, which is JSON-only. The system will be highly available even during server overload because of its small payload size. The modular nature of the MERN stack makes it expandable. New functionalities such as attendance tracking using QR codes or AI-driven event suggestions can be added without redesigning the system [3, 13].

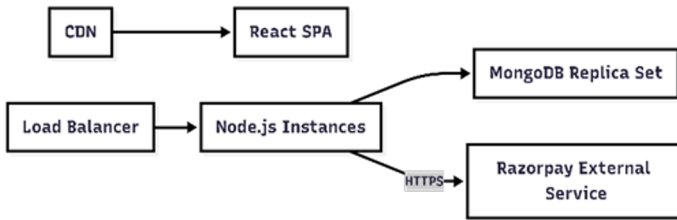


Fig. 7. Scalable deployment architecture handling peak loads during fests

4.5 Scalability and Extensibility

The modular MERN design of CU Live supports future extensions such as:

QR-Code-Based Attendance: Generating QR codes for each registration and scanning them at event entry to reduce manual attendance errors and speed up check-in, as suggested in related college event management systems.[12]

AI-Driven Event Recommendations: Leveraging historical participation and interests to recommend events to students, aligning with research on analytics-driven event optimization.[2, 13]

Mobile Applications: Building Android/iOS clients that consume the same REST APIs to enhance accessibility, similar to future-scope directions in other MERN-based campus systems [2, 4].

These enhancements can be introduced without rewriting the core system, because the backend APIs, authentication, and data model are already modular.

4.6 Limitations

Although CU Live is a solution to most of the existing challenges, several limitations remain. The system assumes reliable internet connectivity amongst the students and administrators; there must be contingency plans in offline situations. Dependency when the payment gateway is an external gateway such as Razorpay, it implies Razorpay event can be impacted by downtime or regional

constraint registrations. Also the existing design is not yet integrated with Institutional Learning or Single Sign-On (SSO) Management Systems (LMS) that would help in smooth onboarding and more advanced analytics. Finally, a wide scale user research and implementation is needed to measure usability, satisfaction, and in a quantitative manner, long-term impact [1, 3, 14].

5 Conclusion

This paper analyzed the current situation in university event management and found that there were serious weaknesses, and manual announcements, as well as decentralized announcements, registering with errors, poor scalability and the lack of secure and integrated payment transactions. Building on prior studies on web based event systems, payment gateways, and the paper proposed CU Live which is a MERN application. MERN-based platform, which is event centralized discovery, registers automatically, and incorporates a secure. financial transaction payment gateway [1-4, 6, 7, 10, 11, 14]

Declarations

Funding. The authors did not receive support from any organization for the submitted work.

Competing Interests. The authors have no relevant financial or non-financial interests to disclose.

Ethics Approval. Not applicable.

Data Availability. Available from the corresponding author on reasonable request.

Author Contributions. All authors contributed to the study conception and design. Material preparation, data collection, and analysis were performed by Punit Kumar, Priyanka Behki, Mansi, Vansh Sharma, Aryan Ranjan, and Ankur Saini.

References

1. Al-Khasawneh, M.A.: A web-based college event management system and notification sender. In: 2022 International Conference on Cyber Resilience (ICCR), Dubai, pp. 1–6 (2022)
2. Kumar, S.S.: Intelligent event finder and management system. In: 5th International Conference on Electronics, Communication and Aerospace Technology (ICECA 2021), Coimbatore, India, pp. 110–115 (2021)
3. Pansare, A., Patil, A., Patil, N., Patil, Y.P., Bhonde, A.: Smart college event management system using MERN stack. *Int. J. Res. Appl. Sci. Eng. Technol.* 11(3), 2045–2049 (2023)

4. Omle, P.G.: e-Vent: Support system for event registration. In: 2nd International Conference on Applied Information Technology and Innovation (ICAITI), Denpasar, Indonesia, pp. 1–6 (2019)
5. Krishna, S.R., Rodrigues, A.: Enhancing payment gateway security: A comprehensive study. *Int. J. Creative Res. Thoughts* 12(9), a1–a9 (2024)
6. Zhang, X., Wang, L.: Key technologies for security enhancing of payment gateway. In: IEEE International Symposium on Electronic Commerce and Security, Guangzhou, China, pp. 123–126 (2008)
7. Masihuddin, M., Khan, B.U.I., Mattoo, M.M.U.I., Olanrewaju, R.F.: A survey on e-payment systems: Elements, adoption, architecture, challenges and security concepts. *Indian J. Sci. Technol.* 10(20), 1–19 (2017)
8. Isaac, J.T., Zeadally, S.: An anonymous secure payment protocol in a payment gateway centric model. *Procedia Comput. Sci.* 10, 758–765 (2012)
9. Sherin Eliyas, N.P., Balusamy, B.: Individualized mastery quest: Crafting customized question papers using React, Node.js, and MongoDB. In: 2024 International Conference on Electrical, Electronics, Communication and Computer Technology (ICEECC) (2024)
10. Kshirsagar, K., et al.: Unified institute management system for efficient administration and accurate data management. *J. Inf. Syst. Eng. Manage.* 9(1) (2024)
11. Chavan, P., Godse, A., Verma, A., Sahani, S., Khatri, R.: Cloud-driven event management system: A comprehensive study. *Int. J. Creative Res. Thoughts* 12(4) (2024)
12. Sharma, S.: Realtime and secure online event voting management system. In: 4th International Conference on Inventive Research in Computing Applications (ICIRCA 2022), Coimbatore, India, pp. 1045–1049 (2022)
13. Kumar, S.V., Shaji, R.S.: Enhancing security in MERN stack web applications: A comprehensive study. *J. Emerg. Technol. Innov. Res.* 11(9), a145–a151 (2024)
14. Gupta, A., Singh, M.: Optimizing event management application through data analytics and dynamic exploration. In: 2nd International Conference on Advances in Information Technology (ICAIT 2024), Bangalore, India, pp. 630–635 (2024)
15. Patel, R., Sharma, S.: Unveiling the world of online payment gateways: Architecture, security, and challenges. *Int. Res. J. Eng. Technol.* 10(7), 288–292 (2023)

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

