A

PROJECT REPORT ON

GCOEY COLLEGE WEBSITE

Submitted in partial fulfilment of requirements for the award of degree of

BACHELOR OF TECHNOLOGY

in

Computer Engineering

By

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2023-2024

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CERTIFICATE

This is to certify that the Project report entitled

"GCOEY COLLEGE WEBSITE"

is a bonafide project work and has been carried out by team:

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Abstract

In the digital age, where technology serves as a cornerstone of modern education, the role of a college website transcends mere information dissemination. Our college website stands as a dynamic virtual portal, meticulously designed to enhance the student experience and foster academic excellence. Navigating through our website, students embark on a journey brimming with opportunities for growth, collaboration, and discovery. From comprehensive course catalogues to interactive academic calendars, every aspect is meticulously crafted to empower students in their educational pursuits. One of the pivotal features of our website is its seamless integration of resources. Students can access a plethora of online libraries, research databases, and academic journals, enriching their learning experience beyond the confines of traditional classrooms. Moreover, virtual learning platforms facilitate engaging discussions, collaborative projects, and interactive learning modules, transcending geographical boundaries and fostering a global community of learners. Beyond academics, our website serves as a hub for holistic development. From career guidance resources to extracurricular activity listings, students are empowered to explore their passions and cultivate a well-rounded skill set. Additionally, dedicated sections for student services provide comprehensive support, ensuring that every student receives the assistance they need to thrive both academically and personally.

Keyword: *Student experience, Academic experience, Digital age, Technology in education, Virtual portal, Online resources, Student Convenience, Student service, etc.*

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Chapter 1: Introduction

1.1 Introduction

Welcome to our college's digital gateway, where innovation meets education, and possibilities abound. In today's interconnected world, where technology reshapes every facet of our lives, our college website stands as a beacon of academic excellence and student empowerment. As you step into this virtual realm, you enter a realm where the traditional boundaries of learning dissolve, and a world of endless opportunities unfolds. Our website is not merely a collection of web pages but a dynamic platform meticulously designed to enhance every aspect of your educational journey.

1.1.1   Concept Of College Website:

- A well-designed college website serves as a comprehensive digital portal that addresses the needs of various stakeholders, including prospective and current students, faculty, staff, alumni, and visitors. The homepage typically features a welcoming message, news and announcements, and quick links to popular sections like admissions, academic programs, and campus news. Essential sections such as "About Us," "Admissions," "Academics," and "Student Life" provide detailed information about the college's history, mission, academic offerings, and student services, ensuring visitors can easily access relevant information.

- Additionally, a robust "Research" section showcases the college's research centers, ongoing projects, and student research opportunities. The "Alumni" section keeps former students connected through alumni associations, event information, and giving opportunities. Ensuring a seamless user experience, the website incorporates responsive design for accessibility on various devices, adheres to accessibility standards for users with disabilities, and features a powerful search function for easy navigation. Finally, security and privacy measures are implemented to protect user data and maintain trust.

1.1.2 Characteristics of College Website:

- **User-Centric Design**: Easy-to-navigate menus and clear site structure to help users find information quickly.

- **Accessibility**: Compliance with accessibility standards (like WCAG) to support users with disabilities, including screen reader compatibility and text alternatives for non-text content.

- **Responsive Design**: Optimization for various devices, including desktops, tablets, and smartphones, ensuring a seamless user experience across platforms.

- **Comprehensive Content**: Detailed and up-to-date information about academic programs, admissions processes, campus facilities, student life, and research opportunities.

- **Engaging Media**: Use of images, videos, and virtual tours to provide a dynamic and engaging experience, helping to visually represent the college environment and culture.

- **Clear Calls to Action**: Prominent buttons and links that guide users to take desired actions, such as applying, scheduling a visit, or contacting the college.

- **Search Functionality**: A robust search engine that allows users to find specific information quickly and easily.

- **Interactive Features**: Online forms for applications, inquiries, and feedback, as well as portals for current students, faculty, and staff to access personalized information and services.

- **Security and Privacy**: Secure handling of personal information, including encrypted connections (HTTPS) and compliance with data protection regulations (like GDPR or FERPA).

- **Community Engagement**: Features like social media integration, alumni networks, and feedback mechanisms to foster community engagement and keep users connected and informed.

1.2 Motivation:

Motivation for a college website could revolve around inspiring and engaging various stakeholders such as prospective students, current students, faculty, staff, alumni, and parents. Here are some motivational themes tailored to different audiences:

1. **Prospective Students:**

   - Showcase Success Stories: Highlight success stories of alumni who have achieved great things after graduating from the college.

   - Virtual Campus Tours: Offer virtual tours of the campus, showcasing its facilities, vibrant student life, and academic resources.

   - Testimonials and Reviews: Share testimonials and reviews from current students, faculty, and alumni about their positive experiences at the college.

2. **Current Students:**

   - Academic Achievements: Celebrate academic achievements, such as Dean's List honours, research awards, and academic scholarships, to motivate current students to strive for excellence in their studies.

   - Student Success Stories: Feature stories of current students overcoming challenges, pursuing their passions, and making a difference in their communities.

   - Leadership and Engagement Opportunities: Highlight leadership and engagement opportunities, such as student organizations, internships, and volunteer programs, to motivate students to get involved and make a positive impact on campus and beyond.

3. **Faculty and Staff:**

- Recognition and Appreciation: Recognize and appreciate the contributions of faculty and staff members through features, testimonials, and awards. Feeling valued and appreciated can motivate faculty and staff to continue delivering high-quality education and support services.

- Collaboration and Innovation: Emphasize the college's commitment to collaboration and innovation, showcasing initiatives that promote interdisciplinary research, teaching excellence, and creative problem-solving.

4. **Alumni:**

- Impact of Giving: Highlight the impact of alumni donations and philanthropic support on the college community, such as scholarships, research grants, and campus improvements. This can motivate alumni and donors to continue giving back and making a difference.

1.3 Scope

The scope of a college website is vast and multifaceted, encompassing a wide range of functionalities, features, and content to serve the needs of various stakeholders within the college community. Here are some key aspects that fall within the scope of a college website:

- **Informational Content**: The website serves as a primary source of information about the college, its history, mission, vision, values, and accreditation.

- **Student Resources:** The website offers a variety of resources and services to support students throughout their academic journey.

- **Faculty and Staff Resources:** The website provides resources and support for faculty and staff members, including access to administrative forms, human resources information, professional development opportunities, teaching resources, and faculty/staff directories.

- **Campus Life:** The website showcases the vibrant campus life and extracurricular activities available to students, including clubs, organizations, sports teams, cultural events, performing arts, and student publications..

- **Academic Support**: The website offers academic support services to help students succeed in their studies, such as tutoring programs, writing centers, academic advising, study skills workshops, and academic integrity resources.

- **Technology Services:** The website provides information about technology services and resources available to students, faculty, and staff, including access to campus Wi-Fi, computer labs, software downloads, online learning platforms (e.g., learning management systems), and IT support.

- **Alumni Engagement:** The website facilitates engagement with alumni by providing opportunities for networking, mentorship, and giving back to the college community

- **Accessibility and Compliance:** The website ensures accessibility and compliance with web accessibility standards (e.g., WCAG) to ensure that all users, including those with disabilities, can access and navigate the website effectively.

1.4 Basic Concept

The basic concept of a college website revolves around serving as a comprehensive online platform that caters to the diverse needs of the college community, including prospective students, current students, faculty, staff, alumni, and parents. Here are some fundamental elements of a college website:

- **Information Hub**: The website serves as a central repository of information about the college, its history, mission, vision, values, and academic programs. It provides details about admission requirements, application procedures, tuition fees, financial aid options, and campus facilities.

- **Academic Programs:** The website features detailed information about academic programs offered by the college, including undergraduate and graduate programs, majors, minors, concentrations, and certificate programs.

1.5 Objective

The objectives of a college website can vary depending on the institution's goals, target audience, and overall mission. However, some common objectives include:

- **Information Dissemination**: One of the primary objectives of a college website is to provide accurate and up-to-date information about the institution, its programs, admissions process, faculty, staff, facilities, and academic offerings. This helps prospective students, current students, parents, alumni, and other stakeholders make informed decisions about the college.

- **Recruitment and Enrollment**: A college website serves as a marketing tool to attract prospective students and encourage them to apply for admission. By showcasing the college's unique features, academic excellence, campus culture, and student life, the website aims to increase enrollment and attract qualified applicants.

- **Student Support Services**: The website provides resources and support services to help students succeed academically, personally, and professionally. This includes information about academic advising, counseling services, career development resources, tutoring programs, disability support services, and student organizations.

- **Alumni Engagement**: The website facilitates engagement with alumni by providing opportunities for networking, mentorship, and involvement in college activities. It helps alumni stay connected with their alma mater, share their success stories, and contribute to the college community through donations, volunteering, and participation in events.

- **Faculty and Staff Support**: The website offers resources and support for faculty and staff members, including access to administrative forms, human resources information, professional development opportunities, teaching resources, and faculty/staff directories.

- **Community Outreach**: The website serves as a platform for community outreach and engagement, sharing information about college events, public lectures, cultural activities, and partnerships with local organizations. It promotes collaboration and interaction between the college and the broader community.

1.6 Software/ Hardware Requirement

1.6.1   System Analysis

System analysis is the process of gathering and interpreting facts, diagnosing problems and using the information to recommend improvements on the system. System analysis is a problem solving activity that requires intensive communication between the system users and system developers. System analysis or study is an important phase of any system development process. The system is studied to the minutest detail and analyzed. The system analyst plays the role of an interrogator and dwells deep into the working of the present system. The system is viewed as a whole and the inputs to the system are identified. The outputs from the organization are traced through the various processing that the inputs phase through in the organization. A detailed study of these processes must be made by various techniques like Interviews, Questionnaires etc. The data collected by these sources must be scrutinized to arrive to a conclusion. The conclusion is an understanding of how the system functions. This system is called the existing system. Now, the existing system is subjected to close study and the problem areas are identified. The designer now functions as a problem solver and tries to sort out the difficulties that the enterprise faces. The solutions are given as a proposal. The proposal is then weighed with the existing system analytically and the best one is selected. The proposal is presented to the user for an endorsement by the user. The proposal is reviewed on user request and suitable changes are made. This loop ends as soon as the user is satisfied with the proposal.

EXISTING SYSTEM

The existing college website is static which makes it less interactive. It doesn't have a database connectivity. Moreover students didn't have an access to the details of the college through the site, hence they were not updated about the latest events and placement drives.

PROPOSED SYSTEM

The proposed college website system will feature a dynamic admin panel designed to streamline content management and enhance user experience. This admin panel will allow authorized personnel to easily update website content, including academic program details, admission requirements, news updates, and event calendars. It will provide intuitive tools for uploading media, managing user accounts, and monitoring site analytics. The dynamic nature of the admin panel ensures that the website remains current and relevant, accommodating real-time changes and promoting efficient communication between the college and its stakeholders. Enhanced security measures will be integrated to safeguard sensitive data, ensuring compliance with privacy regulations and maintaining the integrity of the website. This robust system will support the college's mission to provide accurate, timely information to prospective students, current students, faculty, staff, and alumni.

1.6.2 Hardware Requirements

Disk: Capacity >500MB for smooth performance

RAM: 2GB (minimum) and above.

Processor: Intel Core 2 Quad or Intel i3-5th Gen and above (recommended)

1.6.3 Software Requirements

OS: Windows 7 and above or linux

Front End Technology: HTML5 CSS3, JavaScript.

Backend Technology: PHP & MySql

Code Editor: Visual Studio Code, Notepad or Other Code Editor

Web Browser: Google Chrome, Mozilla Firefox, Opera or Other Web Browser.

Chapter 2: Literature Review

2.1 Overview

What is it?

College websites typically serve as comprehensive online platforms where prospective students, current students, faculty, staff, alumni, and the general public can access information about the institution.

Who can benefit?

- Prospective Students: College websites provide information about academic programs, admissions requirements, campus facilities, and student life, helping prospective students make informed decisions about which college to attend.

- Current Students: Current students can access resources such as course schedules, academic calendars, grades, campus news, and student services through the website. They can also stay updated on campus events and opportunities.

- Faculty and Staff: Faculty and staff can find information about academic policies, administrative procedures, professional development opportunities, campus events, and access internal resources and tools through the website.

What does it involve?

Creating and maintaining a college website involves various steps and tasks, including:

- **Planning and Strategy:** Determine the purpose and goals of the website, identify the target audience, and establish a content strategy. Consider factors such as branding, user experience, accessibility, and mobile responsiveness.

- **Content Creation:** Develop content for the website, including text, images, videos, and other multimedia elements. Content should be accurate, up-to-date, and aligned with the college's messaging and branding guidelines.

- **Design and Layout:** Design the layout and structure of the website, including navigation menus, page templates, and visual elements such as colours, fonts, and

graphics. Ensure that the design is user-friendly, visually appealing, and consistent with the college's branding.

- **Development and Coding:** Build the website using web development technologies such as HTML, CSS, JavaScript, and content management systems (CMS) like WordPress or Drupal. Implement features such as forms, interactive elements, and database integration as needed.

- **Accessibility and Compliance:** Ensure that the website meets accessibility standards (e.g., WCAG guidelines) to accommodate users with disabilities. Comply with relevant regulations and policies, such as GDPR for data privacy and FERPA for student information protection.

- **Testing and Quality Assurance:** Test the website for functionality, compatibility, performance, and usability across different devices and browser.

2.2 Literature Survey

[1] "Usability Evaluation of University Websites" by Al-Turki, et al. (2016)

- **Summary**: This study evaluates the usability of university websites in Saudi Arabia. The researchers used a heuristic evaluation method to assess the websites' navigability, design, content quality, and accessibility. The study found that while many university websites provided comprehensive information, they often lacked user-friendly navigation and accessibility features, which are crucial for effective information dissemination and user engagement.
- **Key Findings**: Importance of user-centred design, need for better accessibility features, and the impact of usability on user satisfaction and engagement.

[2] "Website Usability and Content Accessibility of the Top 10 US Universities" by Jeong and Stylianou (2018)

- **Summary**: This paper examines the usability and content accessibility of the websites of the top 10 universities in the United States. The authors used automated tools and manual evaluation techniques to assess the compliance with Web Content Accessibility Guidelines (WCAG). The study highlighted significant variations in usability and accessibility standards across these websites.

- **Key Findings**: Discrepancies in adherence to accessibility guidelines, need for standardization, and the role of usability in enhancing user experience.

[3] "Development and Evaluation of a Student-Centric University Portal" by Agrawal, et al. (2017)

- **Summary**: This research focuses on the development of a student-centric university portal that integrates various services such as course registration, grades, library access, and event notifications. The portal was evaluated using surveys and usability testing with actual students. The findings emphasized the importance of integrating various services into a single platform to improve usability and student satisfaction.

- **Key Findings**: Benefits of integrated services, user feedback on portal functionality, and the need for continuous updates and improvements based on user input.

[4] "Enhancing University Website Design to Better Meet User Needs" by Huang and Benyoucef (2013)

- **Summary**: This paper explores how university websites can be designed to better meet the needs of diverse user groups, including prospective students, current students, faculty, and alumni. The authors conducted a series of user studies to identify key features and content that users find most valuable. They also provided design recommendations based on their findings.

- **Key Findings**: Importance of understanding user needs, prioritization of content and features, and recommendations for user-friendly design practices.

[5] "Evaluating the Effectiveness of College Websites in Attracting Prospective Students" by McAllister and Lister (2015)

- **Summary**: This study investigates the role of college websites in attracting prospective students. The authors used a combination of analytics, surveys, and eye-tracking studies to understand how prospective students interact with college websites and what information they seek. The results showed that clear navigation, detailed program information, and engaging media content were critical factors in attracting and retaining prospective students.

- **Key Findings**: Effective content strategies, the importance of visual appeal and multimedia, and the impact of website design on prospective students' decision-making processes.

2.2.1 Summary of Literature Review

Table 2-1: Summary of Literature Review

Title	Authors	Summary	Key Findings
Usability Evaluation of University Websites	Al-Turki, et al. (2016)	Evaluates the usability of university websites in Saudi Arabia using heuristic evaluation. Assessed navigability, design, content quality, and accessibility.	Importance of user-centered design, need for better accessibility features, and impact of usability on user satisfaction and engagement.
Website Usability and Content Accessibility of the Top 10 US Universities	Jeong and Stylianou (2018)	Examines usability and content accessibility of top 10 US university websites using automated tools and manual evaluation techniques.	Discrepancies in adherence to accessibility guidelines, need for standardization, and role of usability in enhancing user experience.
Development and Evaluation of a Student-Centric University Portal	Agrawal, et al. (2017)	Focuses on developing a student-centric portal integrating services like course registration, grades, library access, and event notifications. Evaluated with student surveys and usability testing.	Benefits of integrated services, user feedback on portal functionality, and need for continuous updates and improvements based on user input.
Enhancing University Website Design to Better Meet User Needs	Huang and Benyoucef (2013)	Explores how university websites can be designed to meet the needs of diverse user groups through user studies. Provides design recommendations based on findings.	Importance of understanding user needs, prioritization of content and features, and recommendations for user-friendly design practices.
Evaluating the Effectiveness of College Websites in Attracting Prospective Students	McAllister and Lister (2015)	Investigates the role of college websites in attracting prospective students using analytics, surveys, and eye-tracking studies.	Effective content strategies, importance of visual appeal and multimedia, and impact of website design on prospective students' decision-making processes.

Chapter 3: Definition and Methodology

3.1 Problem Definition

The problem definition typically outlines the issue or challenge that needs to be addressed or solved. In the context of a college website, the problem definition could vary depending on the specific circumstances or goals of the institution. Here are some examples of problem definitions related to college websites:

1. **Low Website Traffic**: The college website is not receiving a sufficient number of visitors, resulting in low engagement and limited reach to prospective students, faculty, staff, alumni, and other stakeholders.

2. **Poor User Experience**: Users encounter difficulties navigating the website, finding information, or completing tasks, leading to frustration and dissatisfaction with the user experience.

3. **Outdated Content**: The website contains outdated or inaccurate information about academic programs, admissions requirements, campus facilities, or other relevant topics, causing confusion and misinformation among visitors.

4. **Accessibility Issues**: The website is not fully accessible to users with disabilities, in violation of accessibility standards and regulations, leading to exclusion and discrimination against individuals with disabilities.

5. **Security Vulnerabilities**: The website is vulnerable to security threats such as hacking, malware, data breaches, or phishing attacks, putting sensitive information at risk and damaging the reputation of the college

Research Questions:

- How does the design of the college website impact user experience for prospective students during the admissions process?

- What elements of the website design contribute to positive user engagement and satisfaction among current students and faculty?

- How can the website's navigation structure and layout be improved to enhance usability and accessibility for all users?
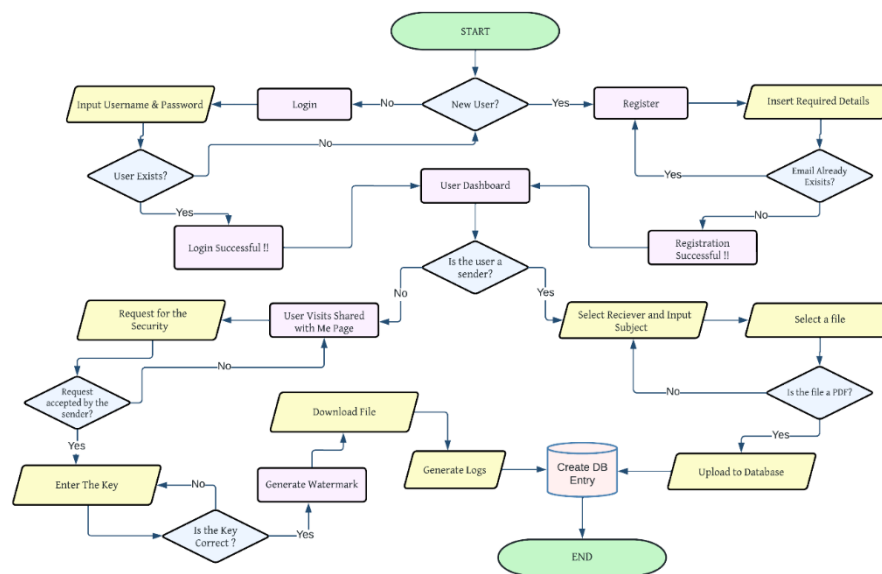
3.2 Proposed Methodology

Figure 3-1: Proposed Architecture

Here's a proposed methodology that can be adapted based on the specific research objectives and resources available:

1. **Literature Review:**

   - Conduct a thorough review of existing literature, research studies, and best practices related to college website design, user experience, accessibility, and impact on recruitment and retention.

   - Identify key concepts, theories, methodologies, and findings that can inform the research study.

2. **Quantitative Analysis:**

   - Collect quantitative data through surveys, website analytics, or quantitative content analysis to gather insights into user behaviour, preferences, and satisfaction levels.

   - Develop and distribute surveys to targeted groups such as prospective students, current students, faculty, staff, and alumni to gather feedback on website usability, content relevance, and overall satisfaction.

3. **Qualitative Research:**

    - Conduct qualitative research methods such as interviews, focus groups, or usability testing to gain in-depth insights into user experiences, perceptions, and needs related to the college website.

    - Schedule interviews or focus groups with representatives from different user groups (e.g., prospective students, current students, faculty, staff) to explore their experiences, challenges, and suggestions for website improvement.

4. **Accessibility Evaluation:**

    - Evaluate the accessibility of the college website using established guidelines and standards such as the Web Content Accessibility Guidelines (WCAG) 2.0 or 2.1.

    - Conduct manual accessibility audits and automated accessibility testing using tools like WAVE, Axe, or Site improve to identify accessibility barriers and areas for improvement.

5. **Content Analysis:**

    - Analyse the content of the college website to assess its accuracy, relevance, and alignment with the institution's goals and values.

    - Use qualitative content analysis techniques to examine the clarity, tone, and comprehensiveness of website content across different sections and pages.

6. **Technology Assessment:**

    - Assess the technological infrastructure supporting the college website, including web hosting, content management systems (CMS), and third-party integrations.

    - Evaluate the scalability, security, and performance of the website's technical architecture to identify potential bottlenecks or vulnerabilities.
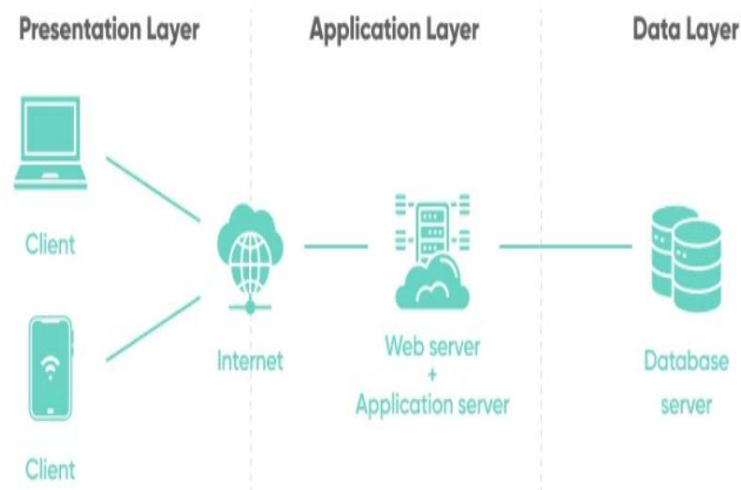
3.3 System Design

3.3.1 System Model
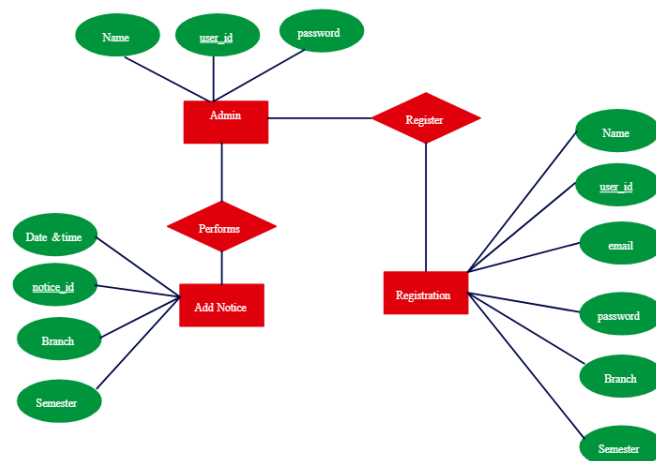

Figure 3-2: System Model

3.3.2 ER Diagram

Figure 3-3: ER Diagram for website administrator

In this ER Diagram, we have four main entities: "User", "File", "Request".

1. The "User" entity represents the users of the system. It has attributes such as Fname, Lname, Date Time, UID, Email, Password, User Type.

2. The File entity represents the data file of user. It has attributes such as Title, Id, User_Id, Date Time, Secret key, About, Name.

3.3.3 Flow Chart
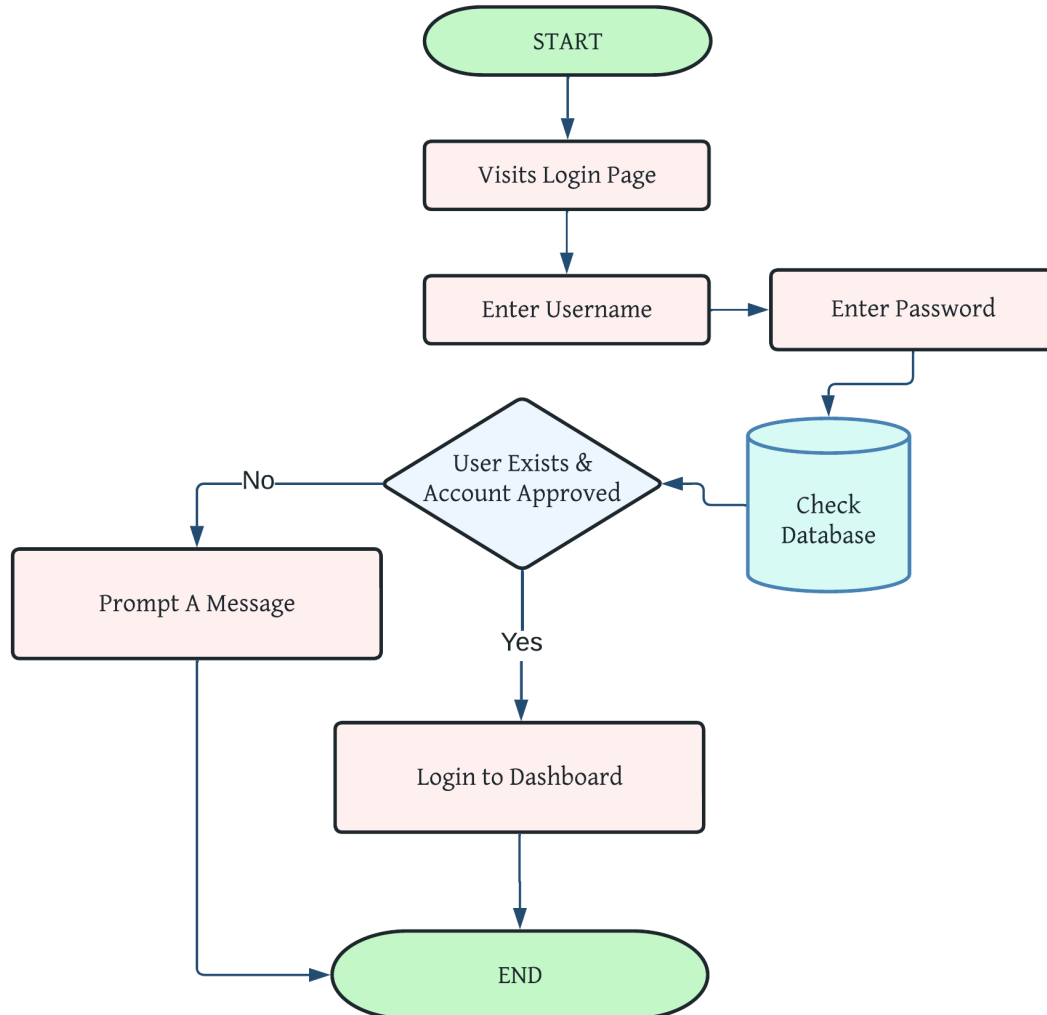
1. Admin Login Page

Figure 3-4: Flowchart for Admin Login Page

The admin begins by accessing the login page and providing their mail and password. Firebase then verifies this information against the database and allows the admin to proceed if the account exists and is approved. If the account is not approved, a prompt message is displayed. Once approved, the admin is directed to the dashboard and the process is terminated.

Chapter 4: Implementation

4.1Backend:

Implementing the backend for a college website using Firebase involves several steps to set up authentication, database, storage, and functions. Here's an overview of the implementation process:

1. Authentication Setup

- **Create Firebase Project**: Begin by creating a new project in the Firebase console.
- **Enable Authentication**: Navigate to the Authentication section in the console and enable the authentication methods you want to use, such as email/password, Google sign-in, or others.
- **Integrate Authentication in Website**: Implement authentication functionality in your website using Firebase Authentication SDK. This includes sign-up, login, logout, and password reset features.

2. Realtime Database or Firestore Setup

- **Choose Database**: Decide whether to use Firebase Realtime Database or Cloud Firestore based on your data structure and requirements.
- **Initialize Database**: Initialize your chosen database in the Firebase console and configure security rules to control access.
- **Connect Database to Website**: Use Firebase SDKs to connect your website to the database and perform CRUD operations (Create, Read, Update, Delete) on data. This includes fetching and displaying information such as course details, event schedules, and user profiles.

3. Storage Setup

- **Enable Storage**: Enable Firebase Storage in the console to store and serve user-generated content such as images, videos, and documents.
- **Set Up Security Rules**: Configure security rules to control access to stored files based on user authentication and authorization.
- **Integrate Storage in Website**: Use Firebase Storage SDK to upload and retrieve files from storage. For example, allow users to upload profile pictures or submit assignments.

4. Error Handling and Logging

- **Handle Errors**: Implement error handling mechanisms in your website to gracefully handle authentication errors, database read/write failures, and other potential issues.

- **Monitor Logs**: Monitor logs and analytics in the Firebase console to track errors, user activity, and performance metrics. Use Firebase Analytics to gain insights into user behaviour and optimize website functionality accordingly.

5. Testing and Deployment

- **Test Locally**: Test backend functionality locally to ensure everything works as expected before deploying to production.

- **Deploy to Firebase Hosting**: Deploy your website frontend and backend to Firebase Hosting using Firebase CLI or integration with your preferred CI/CD pipeline.

- **Monitor Performance**: Monitor website performance, scalability, and security after deployment. Use Firebase tools and services to identify and address any issues that arise.

```
src > API > JS firebase.js > ...
1    import firebase from "firebase/compat/app";
2    import "firebase/compat/firestore";
3    import "firebase/compat/storage";
4    import 'firebase/compat/auth';
5    // import { initializeApp } from "firebase/app";
6    // import { getAnalytics } from "firebase/analytics";
7
8    const firebaseConfig = {
9      apiKey: "AIzaSyDzzr2HvPJH33QTf3py-88y3NIDlv68tqw",
10     authDomain: "gcoey-admin.firebaseapp.com",
11     projectId: "gcoey-admin",
12     storageBucket: "gcoey-admin.appspot.com",
13     messagingSenderId: "316542600568",
14     appId: "1:316542600568:web:16ec507a4f0f97a7a1748d",
15     measurementId: "G-GBF96DJDLF"
16   };
17
18   firebase.initializeApp(firebaseConfig);
19
20   // const app = initializeApp(firebaseConfig);
21   // const analytics = getAnalytics(app);
22
23   export const firestore = firebase.firestore();
24   export const storage = firebase.storage();
25   export const auth = firebase.auth();
26
27
28
29
```

Figure 4-1: Firebase Backend Connection.

The above NodeJS code is helping us to connect to our firebase storage and handle the remaining process from there itself.
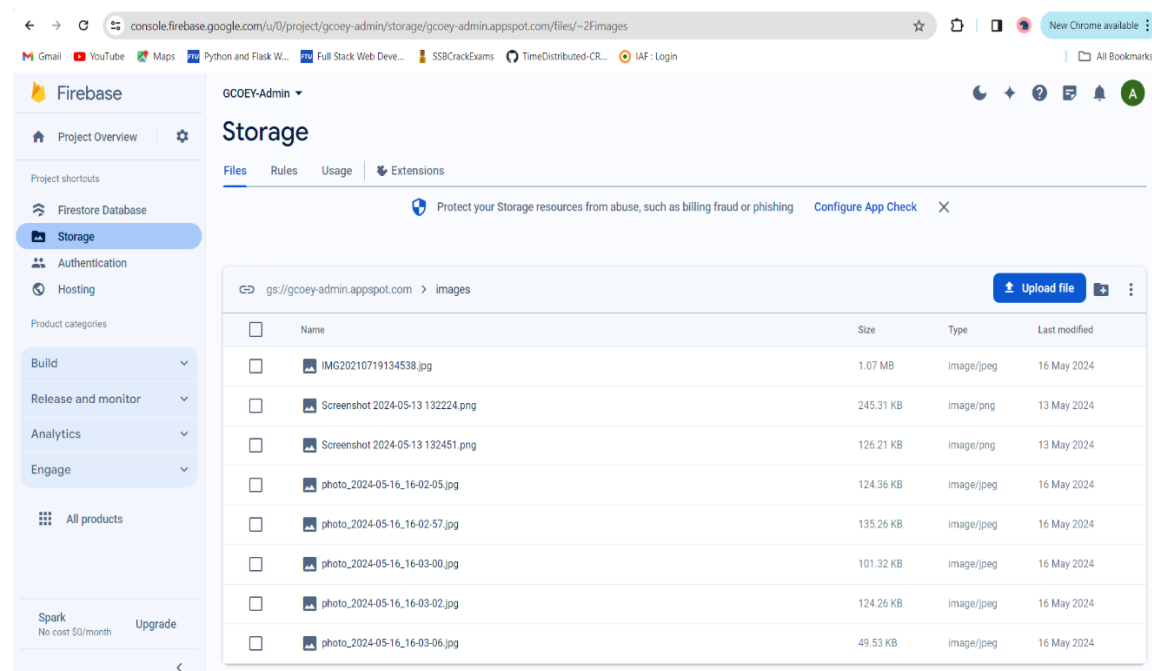
4.2 Database

Figure 4-2: Firebase Storage

Firebase Storage offers a streamlined solution for storing and serving images in your college website. It provides a secure and reliable platform to upload and manage images, ensuring efficient delivery to users. Integrated seamlessly with Firebase services, Firebase Storage simplifies backend infrastructure setup. With features like access control rules and automatic scaling, it guarantees secure storage and swift image retrieval, optimizing user experience. Whether managing user profile pictures, event photos, or campus snapshots, Firebase Storage offers a flexible and scalable solution for image storage needs, making it an ideal choice for building dynamic and engaging college websites.

Additionally, Firebase Storage's integration with Firebase Authentication ensures secure access control, allowing only authorized users to upload or access images. With its seamless scalability, Firebase Storage adapts to your website's growing image storage demands, making it an indispensable tool for creating visually appealing and dynamic college websites.

4.3 User Interfaces

1. Home Page

Figure.4-3: Home Page

In our Project, this the home page of our College website. In the home page we have added the events and achievements which had held in our college.
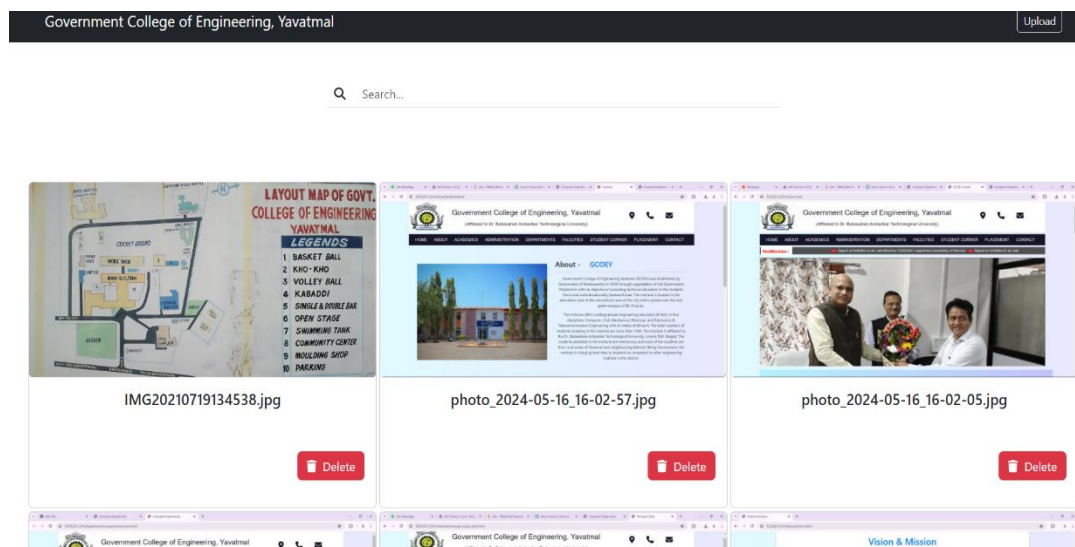
2. Admin Page

Figure 4-4: Admin Page

Admin page is there to upload image for the website and it has many more functionality for the same.

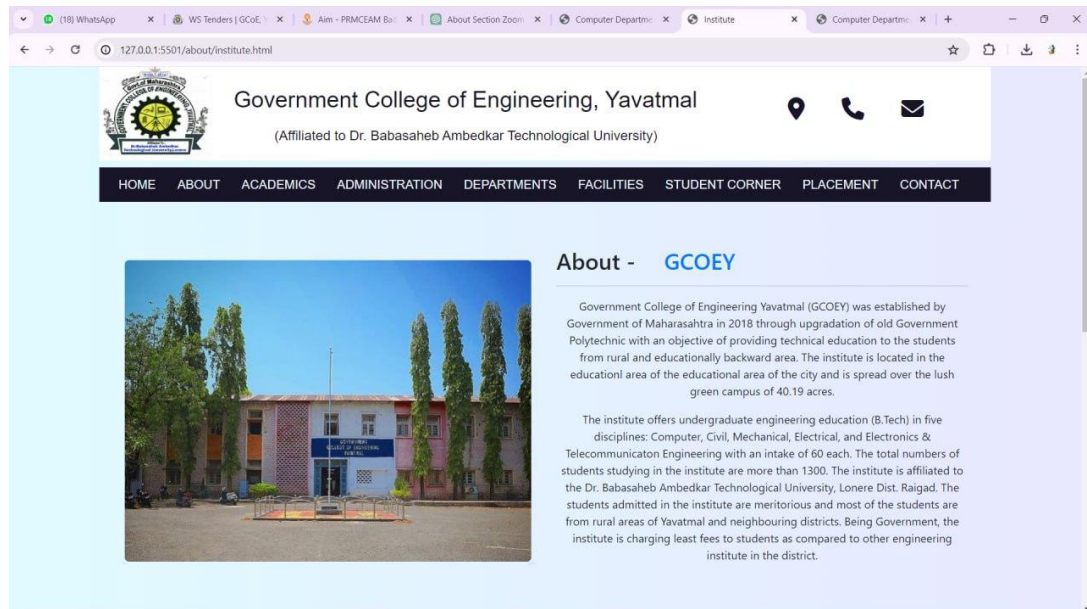3. **User Section**

1. **About Page**

Figure 4-5: About Page

Here we can get the information about the college and various aspect of it.

2. **Vision and Mission Page**

Figure 4-6: Vision and Mission Page
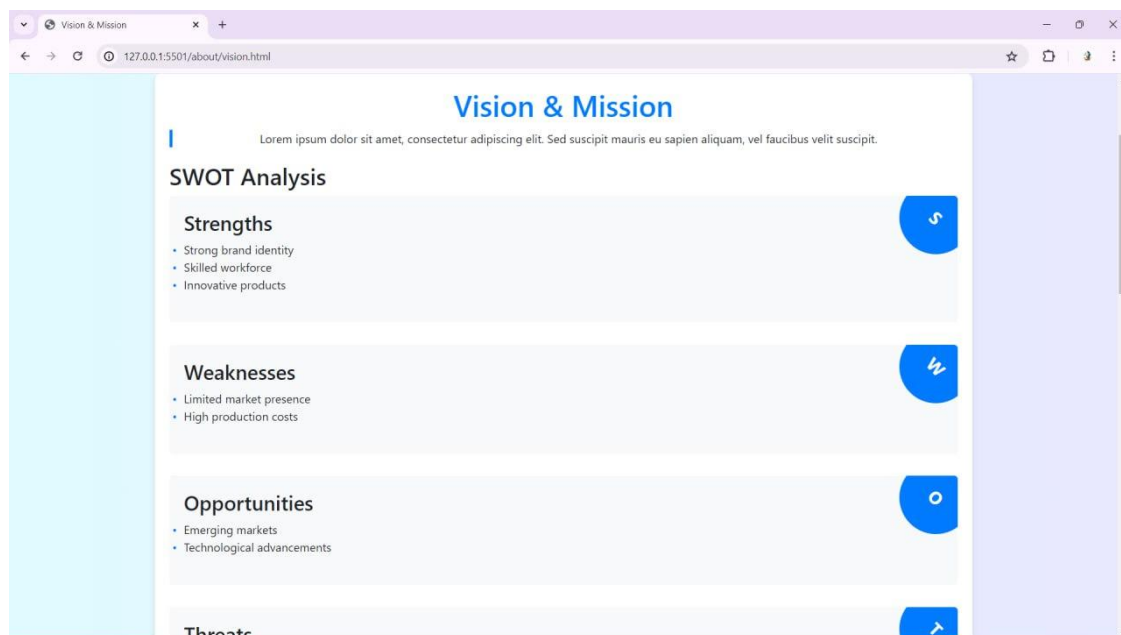
If we want to know about the vision and mission of the college then we can visit here to get the full account of the college SWOT analysis.

3. Contact Page
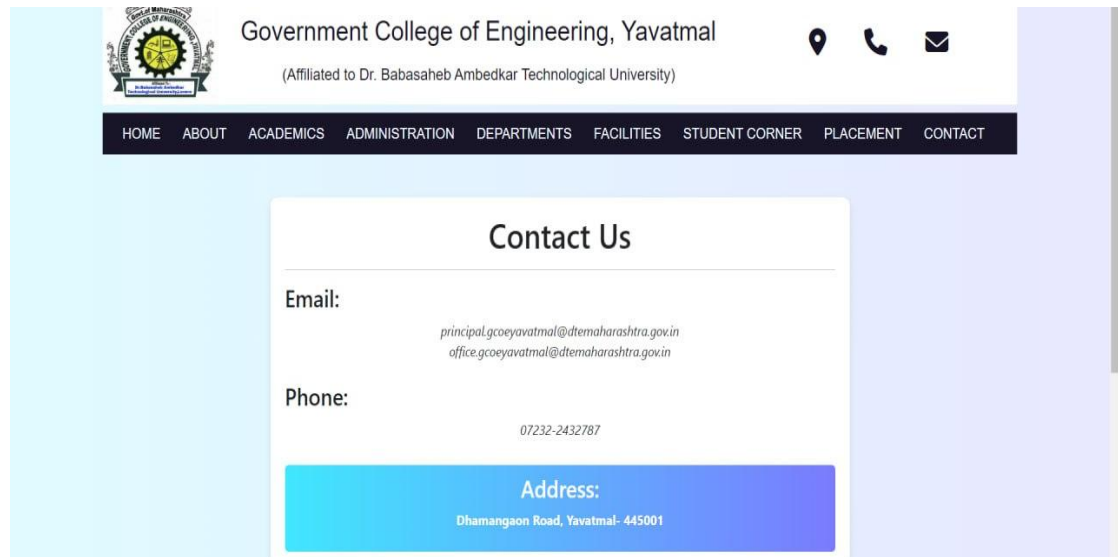

Figure 4-7: Contact Page

If we want to find any contact detail then we can easily search this page.
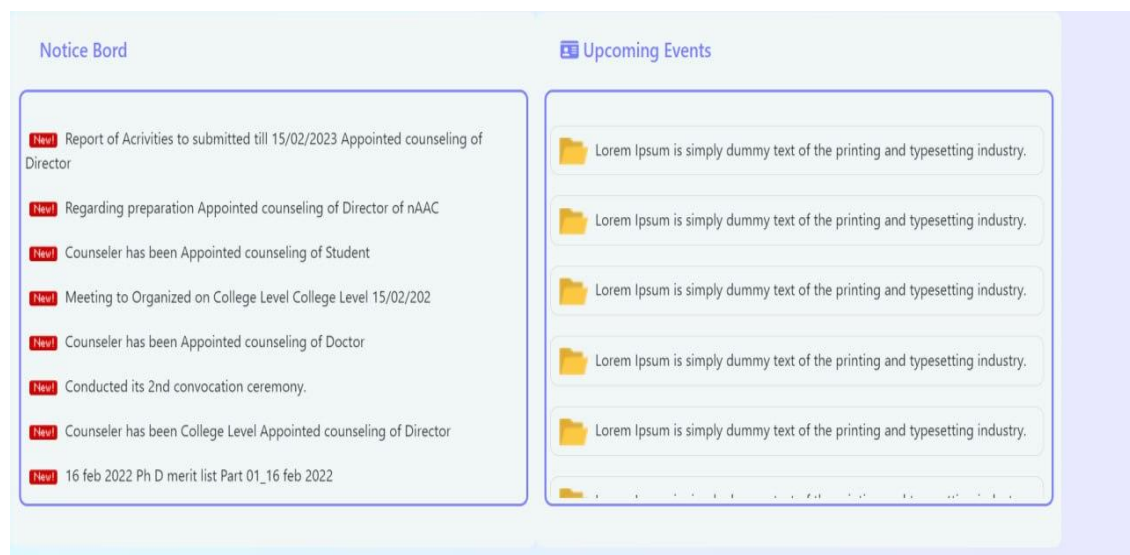
4. Notification Panel

Figure 4-8: Notification Panel

Here we get to know about various ongoing event in the college.

Chapter 5: Result and Discussion

5.1 Result

The results of a college website can be profound, significantly impacting both the institution and its stakeholders. Firstly, from a student-centric perspective, the website acts as a gateway to vital information such as admissions processes, academic programs, and campus events. The website's effectiveness in delivering clear and concise information can streamline the application process, empower prospective students to make informed decisions, and foster a sense of community by showcasing campus life through engaging multimedia content. Furthermore, features like virtual tours and interactive maps enhance the overall user experience, offering a glimpse into campus facilities and amenities.

Secondly, for faculty, staff, and administration, the college website serves as a centralized platform for communication, collaboration, and resource management. It provides access to administrative tools, academic resources, and institutional policies, streamlining workflows and promoting efficiency. Additionally, internal portals and document repositories facilitate information sharing and support collaboration among faculty and staff members. By improving communication channels and providing easy access to essential resources, the website contributes to a more cohesive and productive campus environment. Overall, the results of a well-designed college website manifest in increased accessibility, engagement, and efficiency, ultimately enhancing the educational experience for all stakeholders involved.

5.2 Discussion

College websites represent the digital frontiers of academic institutions, embodying their ethos, mission, and offerings in the online sphere. These platforms serve as comprehensive repositories of information, catering to a wide array of stakeholders including prospective and current students, faculty, staff, alumni, and the broader community. Through meticulously curated content, college websites provide vital resources such as academic program details, admissions guidelines, campus news, event calendars, and student support

services. They serve as dynamic portals facilitating seamless access to essential information and services, thereby enhancing the overall user experience and engagement within the collegiate community.

Beyond serving as repositories of information, college websites play a pivotal role in shaping the perception and identity of academic institutions. Through strategic design elements, multimedia content, and interactive features, these platforms convey the culture, values, and achievements of the college to external audiences. Visually appealing layouts, vibrant imagery, and compelling narratives paint a vivid picture of campus life, academic excellence, and extracurricular opportunities, enticing prospective students and fostering a sense of belonging among current members of the college community. By leveraging digital storytelling techniques and user-centric design principles, college websites contribute to enhancing the institution's brand visibility, reputation, and recruitment efforts in the competitive landscape of higher education.

Furthermore, college websites serve as dynamic communication channels, facilitating dialogue and collaboration among various stakeholders. Through news feeds, blogs, social media integrations, and discussion forums, these platforms foster a sense of community, engagement, and participation within the college ecosystem. Whether sharing campus updates, celebrating student achievements, or soliciting feedback from the community, college websites serve as conduits for meaningful interactions and connections that transcend geographical boundaries. By embracing digital innovations and leveraging emerging technologies, college websites remain at the forefront of facilitating collaboration, innovation, and knowledge dissemination within the academic community, thereby enriching the overall educational experience and advancing the mission of the institution in the digital age.

Chapter 6: Conclusion and Future Scope

6.1 Conclusion

The college website project aims to address key challenges and opportunities related to the design, functionality, and impact of the college website. Through a comprehensive methodology encompassing literature review, quantitative and qualitative research methods, accessibility evaluations, content analysis, and technology assessments, valuable insights have been generated to inform website optimization and strategic decision-making.

6.2 Future Scope

In the future, college websites will continue to play a crucial role in higher education by serving as dynamic digital platforms that facilitate communication, collaboration, and engagement among students, faculty, staff, alumni, and the broader community. Here are several ways in which college websites will be helpful in the future

1. **Enhanced Interactivity and Engagement**: College websites will evolve to offer highly interactive and engaging experiences, leveraging advanced technologies such as gamification, virtual reality (VR), and augmented reality (AR). These features will enable students to explore virtual campus tours, participate in immersive learning experiences, and collaborate with peers in virtual environments. Interactive elements like quizzes, forums, and real-time feedback mechanisms will foster active student engagement and facilitate deeper learning experiences.

2. **Integration of AI and Chatbots**: The integration of artificial intelligence (AI) and chatbots will revolutionize the user experience on college websites. AI-powered chatbots will provide personalized assistance to students, answering queries, offering academic guidance, and facilitating course selection. These intelligent systems will also automate administrative tasks, such as scheduling appointments, sending reminders, and providing instant support, thereby improving operational efficiency, and enhancing user satisfaction.

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Published Paper's

MongoDB: A Comprehensive Review

MONGODB: A COMPREHENSIVE REVIEW

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ABSTRACT

MongoDB is a leading NoSQL database. It has gained worldwide recognition because of its expandable architecture and flexibility. It has been used for constructing data warehouses for data storage as it has proven to be an excellent tool having the ability to completely utilize the "Sharding-Nothing Cluster Architecture" to its fullest extent, which has proven to be a game changer. It can be used to build data warehouses of higher performance as it is an open-sourced database. MongoDB is being used in big data and for building real-time applications. This comprehensive review serves as an illuminating journey into the MongoDB ecosystem, from its inception to its present-day status as an industry leader. We navigate through the fundamental concepts and principles that underpin MongoDB, exploring the architectural intricacies that empower it to handle diverse data management challenges with aplomb. MongoDB's flexible data modeling capabilities form the backbone of its prowess, enabling users to mold data structures that mirror the ever-evolving nature of real-world data. At the heart of MongoDB's appeal is its query language, which is both powerful and intuitive. We dive deep into MongoDB's querying capabilities, unraveling the methods through which data is extracted, manipulated, and transformed to cater to a wide spectrum of applications. In this review, we will focus on various factors of MongoDB and will try to address the key challenges. This paper will help to get a better understanding of MongoDB and identify features to make it better.

Keywords: No-SQL, Mongodb, Database, RDBMS, Non-Relational Databases, Etc.

I. INTRODUCTION

In the 1980s relational database systems were recognized and a person has started creating it. Database systems are used to store the data and do the required manipulation. These systems are used to store and manage data, like business info, finances, and personnel details.. Relational databases store the data points and provide access to similar data points to each other. This traditional relational database can't deal with large amounts of data, it works well on small amounts of data. For storing and handling large chunks of data, "NoSQL" was developed in 1998 by Crlo Strozzi, and is a "non-relational database". In recent times it has also been called "Not Only SQL". There are three types of data available online out of which NoSQL database can manage and store only unstructured and semi-structured data. Unstructured data such as emails, audio, webpages, social media, images, etc can be handled very effectively.

A total of four types of databases are available namely column-oriented, key-value store, graph database, and document store. MongoDB falls into the category of a document-oriented database that runs on a cross-platform environment. MongoDB was first introduced in 2007 by the software company MongoDB Inc. as part of a bigger plan called a "service product". Then the company started developing models as open sourced in 2009. After that MongoDB was recognized as a backend technology by various major websites and companies such as eBay, New York Times, and Craigslist. MongoDB provides features like flexibility, availability, and higher performance. It was written in C++ and mainly works on documentation and collection which is tables in traditional Relational Database Management System. A database is nothing but a box of collections. Collection is a cluster of documents provided by MongoDB. MongoDB database can have a number of collections.[2]

II.   KEY FEATURES OF MONGODB

MongoDB has changed the database system storage and it provides some significant features, such as:

1. Schema-less Database: A particular structure called schema is being followed to store and manage the data and these data should be of similar type but MongoDB offers a useful feature where you can store various types of data like audio, video, and images all in one place. Even the size and structure of your data can vary based on its type and how much there is. This is different from the usual way of storing the data. This feature provided by MongoDB gives adaptability to the database.

2. Document Oriented: In the traditional or usual method of storage like RDBMS, all the data is stored in the tables but here in MongoDB, the data is stored in the files. In these files or documents, the information is stored in fields, like key-value pairs, instead of the rows and columns you see in RDBMS. due to which the data can be accessed easily and it provides more compatibility to the user.

3. High Performance: MongoDB improves the data performance. MongoDB can make data available very quickly as it gives high-performance support. Mongo follows a data model that minimizes the activity of I/O in the database system.

4. Rich Query Language: MongoDB has a language for reading and writing the data that is used to write the queries which will help in the read-and-write operation.

5. High Availability: Horizontal Scalability: A high amount of duplicate data is available so MongoDB provides a facility called replica set to maintain the data having similarity

6. Horizontal Scalability: MongoDB works in clusters and data is divided there by using a sharding method. MongoDB provides this functionality to increase flexibility.[1]

III.   BREIF OVERVIEW OF MONGODB

MongoDB is a leading NoSQL database and it is an open source document-oriented database system. It is based on C++ language. MongoDB operates on the fundamental principles of documents which contains flexible data and collection of organized data. It offers excellent performance, is robust with greater availability, and is highly scalable as it can be operated on various platforms. It is a document that is designed for the easy use of the development of the application. It can be run on the environment such as MongoDB Atlas, MongoDB Enterprise, and MongoDB Community.

• Database - Database is a used to store collected data in large amounts. On data file system every database gets their own set of files.

• Collection - Collection is a cluster of MongoDB documents that is similar to an RDBMS table that stores the documents. Collections do not impose any schema. Documents have different fields within the collection.

• Document - A document contains a set of key-value pairs which is stored in the form of a record. Documents have dynamic schema where dynamic schema refers to the documents in the same collection does not require similar set of fields. MongoDB documents are the same as JSON objects. The field's value can include arrays, some other documents, and arrays of documents.

```
{
name: " John",                    ← field: value
age: 21,                          ← field: value
status: "A"                       ← field: value
groups: [ "music", "sports" ]     ← field: value
}
```

There are various advantages of using documents which includes the dynamic schema that supports the polymorphism, embedded documents, and arrays that reduce the costly joins.[1]

IV.   EVOLUTION OF MONGODB

The development of MongoDB was done by a company in New York in 2009. The first version was basic and the second version had features like improvement of memory, geospatial features, and sharding, and the third version had the aggregation of the framework.
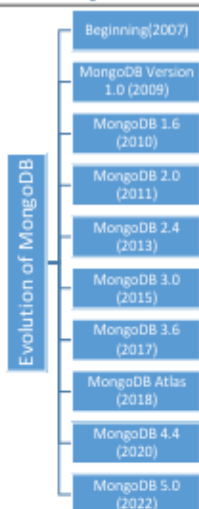
Fig. 4.1 Timeline of MongoDB

1. Early Development (2007-2009): Dwight Merriman, Eliot Horowitz, and Kevin Ryan created the MongoDB in 2007 as the company's part of 10gen. The development of MongoDB was to illustrate the drawbacks of traditional relational databases which handle unstructured data. Initially, Platform as a Service (PaaS) was part of the project but it later evolved into a NoSQL database.

2. Initial Release (2009): In February 2009, MongoDB was first officially released. Version 1.0 was released and made available to the public and it introduced a document-oriented database, which made it easy to work with semi-structured and unstructured data.

3. Growth within Community and Features (2010-2012): With rapid growth MongoDB gained popularity by attracting a vibrant and enthusiastic community of users and contributors. In 2010, MongoDB 1.6 was introduced with features like sharding that allowed the horizontal scaling of the data. In 2011, MongoDB 2.0 supported the aggregation of frameworks and was durable.

4. Aggregation Framework (2013): The introduction of the aggregation framework was supported by the MongoDB 2.2 version which marked a significant development. This framework allowed users to perform complex data transformations and analytics within the database itself.

5. WiredTiger Storage Engine (2014): In 2014, MongoDB 3.0 introduced the WiredTiger storage engine as an alternative to the MMAPv1 engine. This improved performance, concurrency, and compression capabilities, making MongoDB even more efficient.

6. MongoDB 3.6 (2015): It included improvements such as changes in streams for real-time monitoring of the data.

7. MongoDB Atlas (2016): MongoDB launched MongoDB Atlas, a database as a service platform, in 2016. This cloud-based service made it easier to deploy and manage MongoDB databases, further simplifying the development process.

8. Multi-Document ACID Transactions (2018): The release of MongoDB 4.0 introduced multi-document ACID transactions, which was a long-awaited feature for users requiring complex data integrity and consistency and was available for simplifying the database management and its deployment.

9. Serverless and Mobile Development (2020s): MongoDB 4.4 version was introduced which had features like MongoDB Realm which is used for serverless computing and mobile development, which made that more accessible and suitable for distributed applications.

10. Present Innovation (Ongoing): MongoDB is continuously evolving with regular updates and improvements. It will remain advantageous over traditional NoSQL databases also it has some magnificent features like serverless databases and distributed transactions which will enhance its usage and scalability.

V.   WORKING OF MONGODB

In MongoDB, we have the power to create multiple databases after creating an environment. As MongoDB is a NoSQL database the data is stored in the form of documents and collections. Like the MYSQL database table here in MongoDB we have collections. In MongoDB, we can create several collections and several databases. Inside every collection we have documents. In this document, we store the data and every collection has multiple documents and each document may or may not be similar to one another. We use fields to create documents. Fields have key-value pairs like columns in RDBMS. Field can contain values like Boolean, double, string, binary, etc.

In MongoDB data is stored in the form of BSON format which is an acronym of Binary representation of JSON documents. Subsequently, MongoDB works as backend development in which the server converts the JSON data into a binary form which is also known as BSON. This BSON is queried and stored efficiently. The data in MongoDB is stored in nested form. Due to this nesting, the complicated relations can be created in the data. In comparison with the SQL, the access of data is easier in MongoDB. 16MB is the maximum size for the BSON documents.
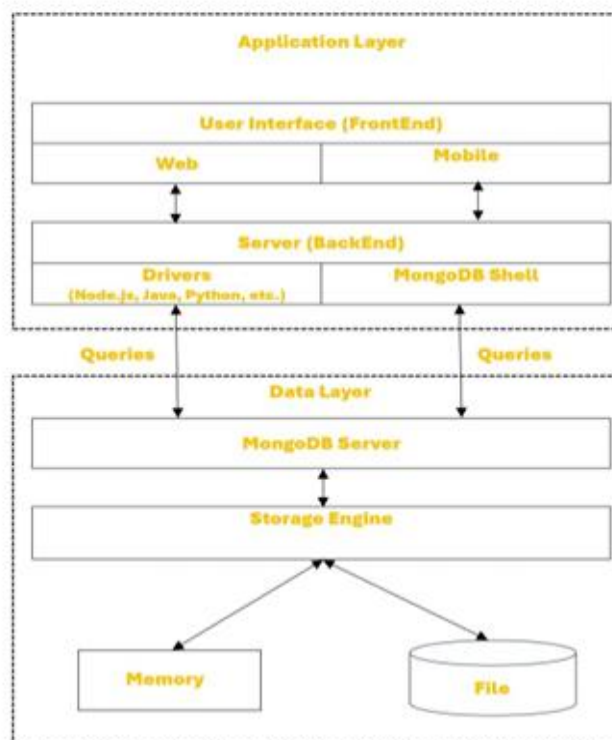
Fig. 5.1 Mechanism of MongoDB

VI.   USE CASES OF MONGODB

Some of the use cases of MongoDB with case studies are as follows:

1. Content Management Systems (CMS): - We use MongoDB in our Content Management System as a database, where we can store different formats of files like images, videos, text, as well as audio, and many more. MongoDB provides us flexibility for managing all these types of files very efficiently. A prevalent news website uses MongoDB to store, manage as well and serve a massive amount of content to adjust to changing user queries.

2. E-commerce: - In the E-commerce sector, we generally deal with information like product details, user details, and order-related data. So, to store them we use MongoDB as it also provides us the ability to store and handle large volumes of data very easily. A big player in the online retail market uses MongoDB to manage user profiles and inventory so they can work very reliably during the peak sales season.

3. Internet of Things (IoT): - when we talk of IoT one thing that is very come is the large volume of data. So, to store it we need some better options and MongoDB is one of them as it gives us real-time capabilities. A smart home automation company counts on MongoDB for crucial data storing as well as analyzing and allowing the user to monitor and control the home distantly.

4. Healthcare: - We can use MongoDB in the health sector for storing the patient health record and various images regarding the patient's tests.

5. Geospatial Applications: - As we have different geospatial capabilities in MongoDB it is the best choice for the app that requires location-based information. This includes Mapping services, logistics services site-based publicity, etc. A well-known ride-sharing company trusts MongoDB to manage the driver and riders' location in real-time, helping the company to effectively match the nearby pair of the rider and driver.

VII. CONCLUSION

As the database technologies are increasing day by day MongoDB is emerging as the dynamic and dominant player, leaving a permanent mark on the scope of NoSQL databases. MongoDB has proven its strength in various data-driven operations, the ease of scaling, and adaptability. After comparing different databases with MongoDB, we can highlight the reason for its dominance in the field. This review in its entirety is not just a retrospective assessment but also the progressive compass, directing toward the future of database technology. As the data is continuously evolving with high velocity MongoDB is proving its key features like scalability, adaptability, and innovation. MongoDB is far more getter than just the database it is a collaborator between the management.

As nowadays NoSQL is in high demand many researchers have been attracted to this database category. MongoDB stores the data in a key-value format which makes it very efficient to aggregate the massive data. It can store various types of data like arrays. In MongoDB mapping of data is easy because of the format of the stored data. So, we can say that MongoDB stands as the proof of the transformative databases solution. This comprehensive review of MongoDB servers is an essential guide for people who want to unlock the door of the data-centric world. This will help them to understand the true potential of MongoDB and find innovative ways to implement it with ease in the rapidly growing data world.

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A Comprehensive Review of JavaScript Frameworks

A Comprehensive Review of JavaScript Frameworks

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Abstract— **As the web is getting global recognition, the internet development sector is adapting the HTML5 and CSS3 generation and JavaScript is becoming increasingly more powerful. Developers are using brand-new technology to choose the JavaScript Framework which will help to reduce the complex coding steps and provide a cross-browser platform. This comprehensive review paper, titled "Exploring the Landscape: A Comprehensive Review of JavaScript Frameworks," gives a multifaceted overview of JavaScript Frameworks. Also, this overview represents the evolution of JavaScript itself, examining the role of Frameworks in enhancing code maintainability, developer productiveness, and user experience. This paper focuses on the industrial adoption of these frameworks, their applications, and their impact on web improvement traits. This review paper includes the JavaScript Frameworks: AngularJs, Nodejs, React, jQuery, and their influence on ongoing and upcoming technologies. It guarantees with evolution of JavaScript frameworks, thinking about emerging technologies and evolving principles to form the web development landscape.**

Index Terms— **Web Development, JavaScript, AngularJs, Nodejs, React, jQuery, etc.**

I. INTRODUCTION

The Internet is a huge pool of languages, protocols, and practices that are used in the development of websites applications, and Internet packages. One of them is JavaScript, commonly denoted as 'JS', a programming language that is the core technology for the internet along with HTML and CSS. As per the current report of 2023, 98.7% of website, applications use JavaScript on the client side for the working of the website by incorporating the in-built libraries. JavaScript libraries or code run on its dedicated environment. All the available web browsers have specialized JavaScript engines to run the code on the system of the customer. JavaScript is a high-level, widely used compiled language that follows the ECMAScript Standard. It uses prototype-based object orientation and first-class functions. JavaScript is an interpreted and script-based language to build web applications that allow programmers to interact with web pages. As an end result, some of the less sophisticated ports of computer-like packages have become on hand as net pages. One example was the mail client Gmail of Google.

Here, we refer to internet pages as web applications that have APIs for running the text, dates, data structures, regular expressions, and the Document Object Model (DOM) to manage the files. Social Networking is a live example of the use of an internet package. Facebook is a famous website that has been listed by Alexa on Range 2. A total of 25 websites are used for social networks, e.g., Facebook, Twitter, etc. Much research has been done that shows that social networking net programs are present that are made available by JavaScript libraries. JavaScript has grown as a famous programming language after getting recognized by net packages. The review paper is determined to present four popular JavaScript frameworks - AngularJs, Nodejs, React, and jQuery to show their fault, features, and benefits which will offer a side-by-side evaluation as per the analysis or testing [1]. We can also add some technology that will make the use of packages more independent and secure. The rest of the paper is organized as follows. Segment II provides the Beginning of JavaScript, and then phase III provides the Timeline of JavaScript. Phase IV benchmarks the popular framework of JavaScript that we use for development. Phase V gives trending JavaScript frameworks. In Phase VI, we conclude our analysis of JavaScript frameworks.

1

II. BEGINNING OF JAVASCRIPT

The JavaScript was started in the mid-1990s. Here is a brief overview of its beginning:

A. JavaScript Invention

JavaScript was developed in May 1995 by Brendan Eich within 10 days. He worked at Netscape and applied the observed concept of JavaScript for his web browser, Netscape Navigator. Earlier most of the parts of client-side web pages had to be carried out in Java. JavaScript has become a linking language to connect and coordinate with Java. It helps different parts of a system or software that use Java to work together effectively. JavaScript also helps to make static web pages more interactive. As JavaScript holds the position of helping Java, JavaScript had to behave and appear like Java.

B. Standardisation of JavaScript

JavaScript follows certain standards: The number 1 well-known is ECMA_262, which is hosted through ECMA-International. The secondary widespread is ISO/IEC 16262, hosted by the Worldwide Company for Standardization (ISO) and the Worldwide Electro-technical Fee (IEC). Using above mentioned standard some languages were defined that are referred to as ECMAScript, instead of JavaScript. The new name was chosen by Sun Microsystem which is now known as the Oracle as the trademark for the former name. The word "ECMA" in "ECMAScript" comes from the first standard which was hosted by the name of an organization. Earlier, the organization was named ECMA, which was represented as the European Computer Manufacture Association. Afterward, the name was changed to Ecma International, Ecma being an actual name and no longer an acronym. This was transformed because the Organization expanded its operation which was beyond Europe. The preliminary use of all capital letters in the acronym clarifies the word ECMAScript.

C. Evolution of JavaScript

Over the years JavaScript has taken control of the progress of web development and has evolved totally. In the initial days of JavaScript, it was only being used to add simple interactivity within web pages. But with the continuous updation and evolution in JavaScript, new features have been added that make it more powerful and easier to use. For example, ECMAScript 2019, the latest version of JavaScript, introduces new features and improvements to JavaScript such as asynchronous functions, classes, and modules. These features have made a huge impact on JavaScript development by enhancing code readability, maintainability, and performance. The evolution of JavaScript has made it a powerful and versatile programming language. Now it is used to create a wide variety of web applications. As there is continuous evolution and updation in the language, it will become even more powerful and popular.

III. TIMELINE OF JAVASCRIPT

Over the years, JavaScript has turned into a multiprogramming, versatile, and powerful programming language from a simple scripting language that can be used for web development, server-side programming, and many more. Here's a timeline of the major milestones and developments in the history of JavaScript:

A. Birth of JavaScript (1995):
Brendan Eich created JavaScript in only ten days while running at Netscape Communications and is first known as "Mocha" and later known to be "LiveScript," it is ultimately named "JavaScript".

B. JavaScript Standardization (1996):
JavaScript is submitted to ECMA global (European Computer Manufacturers Association) for standardization, resulting in the first version of the ECMAScript general.

C. ECMAScript-2 (1997):
The second edition of ECMAScript is launched with minor updates to the language.

2

D. ECMAScript-3 (1999):
ECMAScript 3 is delivered, including numerous new capabilities and enhancing the language's balance. This model will become widely supported in web browsers and remain well-known for decades.
E. Browser wars and DOM Manipulation (2000s):
JavaScript will become critical to net development, with the introduction of the document object version (DOM) for dynamic internet page manipulation. The "browser wars" era ended in compatibility troubles as distinct browsers put in force JavaScript differently.

F. ECMAScript-5 (2009):
JavaScript will become critical to net development, with the introduction of the document object version (DOM) for dynamic internet page manipulation. The "browser wars" era ended in compatibility troubles as distinct browsers put in force JavaScript differently.

G. Node.js (2009):
ECMAScript 5 is launched, introducing strict mode, JSON help, and numerous new array strategies.

H. ECMAScript-6 (ES6) (2015):
ECMAScript 6, additionally called ES6 or ECMAScript 2015, is launched, bringing foremost language improvements like arrow functions, training, modules, and template literals.

I. WebAssembly (Wasm) (2017):
WebAssembly (Wasm) is introduced, making allow to the near-native for the speed execution of the low-level code in internet browsers.

J. ECMAScript 2019 (ES10) (2019):
ECMAScript 2019 introduces capabilities like Array.prototype.flat(), Array.prototype.flatMap(), and non-compulsory capture binding.

K. ECMAScript 2020 (ES11) (2020):
ECMAScript 2020 consists of functions like Big int for the arbitrary precision integers.

L. ECMAScript 2021 (ES12) (2021):
ECMAScript 2021 introduces new capabilities along with the "String.prototype.replaceAll()" technique, logical task operators, and Promise.any().

M. Future ECMAScript Versions (Ongoing):
The TC39 committee continues to paint on proposals for the upcoming ECMAScript versions, ensuring that JavaScript stays a dynamic and evolving language.
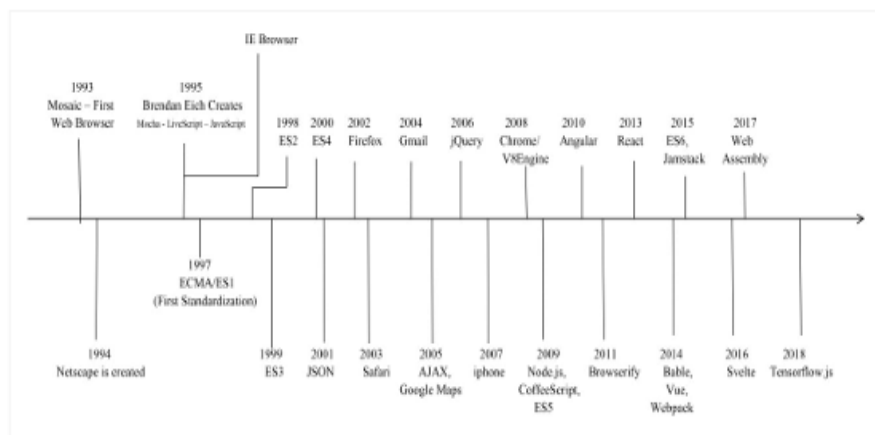

FIGURE 3.1 EVOLUTION OF JAVASCRIPT

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IV. POPULAR JAVASCRIPT FRAMEWORKS

A web framework that is abbreviated as 'WF' or the web application framework (i.e. WAF) is a software interface that supports the web application or the development of frameworks that include the resources and services required for the web and web API's. A JavaScript Framework is a comprehensive set of in-built JavaScript Snippet's code libraries that gives pre-written code for regular programming tasks to a web developer or programmer to build a web application more efficiently. JavaScript works well for both front-end as well as back-end development with its frameworks.

TABLE I. JAVASCRIPT FRAMEWORKS

Front-end Frameworks	Back-end Frameworks
1. React	1. jQuery
2. Angular	2. Node.js
3. Vue.js	3. Express.js
4. Ember.js	4. NetJS
5. Backbone.js	5. Koa.js

A. Why do we have a number of JavaScript frameworks?

JavaScript Frameworks are created to provide pre-written code so that it can fulfill the changing needs or emerging advancements in web development. These Frameworks are designed to take advantage of new features and capabilities evolved. These Frameworks made it possible for the developers to create modern web applications.

One of the factors on which the development of Frameworks depends is Developer preferences and philosophies. Some developers focus on user requirements, structure, and opinions which were observed in Angular and Ember. Others prefer the use of lightweight libraries like React or Vue. These differences in the opinions and preferences of developers were the main reason for the creation of so many frameworks, where every framework carries out a different task.

B. Analysis of Frameworks

Some of the frameworks that our review paper is basically based on:

a. ANGULAR

AngularJS is a front-end-based web application. The first version of this framework was created in 2010 by Google, and the recent version that is actively in use is version 1.7 which was developed in 2018. It can be used in the HTML page by adding a <script> tag. AngularJS focuses on extending the attribute of HTML by making use of pre-processor directives and binds data by using the expressions to HTML.

AngularJS follows the MVC design pattern that divides the program into three major parts: the model, the view, and the controller. This division can help to represent how data is stored, its presentation to the user, and management by the program. Angular has transformed the traditional server-side rendering service into client-side web programs with the help of "dependency injection". This will also help to reduce the burden on the server. Out of the three parts: the model shows how the data is stored, the view displays the data and the controller focuses on managing the input and making the updation in the model whenever needed.

AngularJS is a well-known framework for creating single-page applications. In a single-page web application, all the content is loaded on a single page which has become more responsive and faster than traditional web applications after using the AngularJS features. AngularJS is a powerful framework that is used to build a number of web applications. It is mainly used by developers who want to create dynamic and interactive web applications.

b. REACT

React was developed by Jordan Walke, who was a software engineer at Meta, who released an early rough model of React called "FaxJS". Its first deployment was in 2011 on Facebook's News Feed and later it was deployed on Instagram in the year 2012. It was open-sourced at JSConf US which was held in May 2013. React Native supports iOS, and native Android and also allows the creation of a Universal Windows

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Platform (UWP) app using React. The official announcement about this was made in February 2015 at Facebook's React Conf. Afterward, in March 2015; it was made open-source.

React or React.js or ReactJS is a frontend JavaScript library that is free and is being used to build application-based interface components for users as it is open-sourced. Now, Meta which was earlier known as Facebook, and Individual developers groups, and companies maintain React. It is combined with the Next.js framework to develop mobile, single-page, or server-side rendering web applications. React mostly focuses on rendering components and the user interface to the DOM, React provides routing and client-side functionality, which relies on packages.

In React, the code works in components that are made up of elements. These components are used to develop a software application in terms of modules. Programs built in React mainly consist of multiple layers of components. With the help of the DOM library provided by React, we can display these components on the web page. To display components and share information between these components values are used through properties (mainly called props). Internally, information about a component is stored in something called 'state'. Components can be declared primarily in React, i.e., through class and function components.

c. jQUERY

Originally jQuery was created at BarCamp by John Resig in January 2006. He was influenced by the earlier CSS Query library that was created by Dean Edward. Currently, a group of developers, under the leadership of Timmy Willison, is maintaining this framework with a selector engine of jQuery, with its component, Sizzle, led by Richard Gibson. This design was developed to make it easier for the developer to traverse the tree structure of HTML DOM and handle the changes in HTML, manage events, apply CSS animations, and work with Ajax. It is open-sourced, free-for-all software under the agreeable MIT License.

The syntax of jQuery is designed to simplify document navigation, make the DOM element selection easier, manage events, and develop Ajax applications more efficiently. jQuery is highly valuable for developers as it offers the ability to develop plugins above the libraries of JavaScript. jQuery operates a Domain Object Model (DOM) based library that provides powerful manipulation capabilities. The DOM serves as a tree-like structure representing all the components within a Web application, and jQuery simplifies the syntax to find, select, and manipulate these DOM components, enhancing the development process.

jQuery offers compatibility with the "current-1 versions" of popular web browsers, including Firefox, Safari, Edge, Chrome, and Internet Explorer 9, which is the current stable version of the browser. For mobile devices, jQuery supports iOS 7 and Android 4.0, along with later versions of these operating systems.

d. NODE.JS

The very first server-side rendering environment for JavaScript, 'Netscape's LiveWire Pro Web' was developed in 1996 and after about thirteen years Node.js was introduced in 2009. The available versions initially supported operating systems like Linux and Mac OS X only. Initially, Node.js was maintained by Dahl and afterwards, it was owned by Joyent. Node.js can run on various operating platforms such as Unix, Linux, Windows, and Mac OS because it is versatile and has an open-source server environment. Node.js is a backend framework that provides an environment for running the program on the V8 engine of JavaScript and it executes the code external to a web browser. Node.js can allow the programmer to write command-line arguments using JavaScript tools and can also be used for scripting server-side.

Node.js follows a "JavaScript everywhere principle" which represents that a single programming language is enough to develop a web application instead of using multiple programming languages for server-side programming versus client-side programming. Node.js supports event-driven architecture which is used to improve scalability, performance, and flexibility in a software design.

In Node.js event-driven architecture is implemented using the modules of the event loop and event emitter that provide a powerful group of tools for managing different object events and making it able to asynchronous with I/O. The motive for the use of this design is to improve the output in web applications for real-time communication programs and various web applications and to improve scalability with too many operations of input/output.

C. Comparison of frameworks

We have compared the above-discussed framework based on various metrics. One can easily find the best-suited framework for their project by reviewing this comparison.

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TABLE II. TYPE SIZES FOR CAMERA-READY PAPERS

Parameters	Angular	React	jQuery	NodeJs
Type	Front-end framework	JavaScript library	Server-side runtime	Front-end library
Component-based	Yes	No	No	Yes
Templates	HTML-based templates	HTML/ JavaScript	No	JSX (JavaScript)
Routing	Built-in(Angular Router)	Manual/Third-party	Express.js	React Router
Community & Ecosystem	Large, but divided	Large	Large	Large
Popularity	Declining	Declining	Growing	Very popular
Real-time applications	Not typically used	Possible, but manual	Ideal for real-time	Used with web socket

Let us understand the emerging frameworks which are useful in designing the architecture of web applications in day-to-day life.
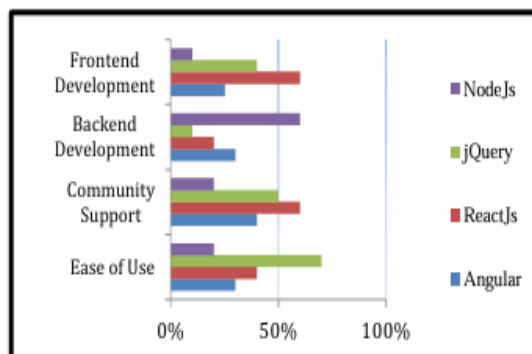
FIGURE 3.2 GRAPHICAL REPRESENTATION OF TRENDING FRAMEWORKS

D. ARCHITECTURAL VIEW OF FRAMEWORKS

JavaScript frameworks such as Angular, React.js, and Vue.js work on a component-based architectural pattern, focusing on the creation of UI components that are reusable and summarize both the logical and the presentation layers(JSX or template). These frameworks allow structured rendering by utilizing a virtual DOM(for React) and imparting working for statistics binding, where it ensures the view should display changes in the underlying records. Angular supports a dependent technique while Vue and React provide greater flexibility. In review, Node.js is not a frontend framework anymore still it uses an event-pushed and non-blocking I/O structure to construct server-aspect applications and APIs, and routinely interacts with frontend frameworks and libraries with the help of restful APIs [1].

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TABLE III. ARCHITECTURE AND TECHNICAL POSSIBILITIES

Runtime/ Framework	Angular	React.js	jQuery	Nodejs
Architecture	Component-based	Component-based	Not component-based	Event Driven, Non-Blocking I/O
Templates	Angular Templates	JSX (JavaScripts XML)	HTML/ JavaScripts	Not allowed templates
Built-in Validation	Yes	Limited(with third-party libraries)	No	Not allowed built-in validation
Building of Models & Views	Components & Services	Components & State	DOM Manipulation & Event Handling	Server-side Development
Compatibility with Other Libraries	Compatible with RxJS for observables and various libraries	Compatible with many libraries due to its component-based architecture	Compatible with various plugins and libraries, but it's not a framework	Compatible with a wide range of npm packages and libraries

E. ANALYSIS OF FRAMEWORKS

Different types of testing have been supported by all four frameworks. Some support functional or black box testing and others support structural or white box testing. Karma and Jasmine are the famous JavaScript testing modules supported by AngularJS, Jest, mocha by React, Qunit by jQuery, and many others.

a. Performance
Different Characteristics have been revealed after performing the performance testing of Angular, jQuery, Node.js, and React. AngularJS is a robust technology but due to its framework size, it can exhibit longer initial load times, it recounts with fast runtime performance, especially with Ahead-of-Time(AOT) compilation.jQuery has a lightweight nature so it dominates the initial load time, but for complex applications, jQuery's runtime performance may lag behind modern frameworks.Node.js is proficient in server performance as it supports a non-blocking I/O feature that makes it ideal for real-time applications. React offers rational load times, mainly with server-side rendering, and also maintains an outstanding runtime performance because of its Virtual DOM and component-level updates. Each technology has its own choices, weaknesses, and strengths that should align with specific project requirements and priorities [1].

b. Security
All the Frameworks Angular, jQuery, Node.js, and React have evolved in the various considerations for security purposes. Angular provides protection against cross-website Scripting (XSS) attacks and strong safety features. The right setup is needed to prevent move-web site Request Forgery (CSRF) attacks as Angular's exceptional practices are analytical for protection. jQuery which consists of a DOM manipulation library doesn't provide security features instead it provides the environment for the user to be comfortable with coding practices, server-side security measures, and for entering validations. Node.js provides security when configured properly but due to bad coding practices, it can have powerlessness, authentication, remote server safety measures like Helmet, and making input validations. React's security measure depends on the right data management and coding practices that include input sanitization to prevent XSS attacks. We can implement server aspect rendering (SSR) to beautify protection. To retain software safety efficiently, we have to follow a configured approach and stay knowledgeable about best safety practices. The selection of best practices needs to be aligned with unique safety necessities and development practices [1].

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V. JavaScript Cutting-Edge

We are entering into the third generation of net services. Web services and technologies have been evolving constantly and JavaScript continues to be an important part of this evolution. JavaScript has been transformed over the years and it is a core technology for web development.

All the new Frameworks that have been developed are being advanced all the time. Therefore, we have to stay up-to-date in JavaScript development.

Vue.js is making a great impact on today's web era with its flexibility, versatility, and overall performance. Vue.js can evolve seamlessly due to its modular structure to a variety of task requirements to manage small interactive widgets as well as complicated single-page packages. Vue.js offers strong aid for server-side rendering technology, growing internet apps, accessibility, and internationalization as it understands modern-day net technology.

Vue.js is poised to have a profound impact on the present-day web era with the aid of virtue of its simplicity, flexibility, and overall performance. Vue's modular structure lets evolve it seamlessly to an extensive variety of task requirements, from small interactive widgets to complicated single-page packages. Vue.js aligns with modern-day net technology trends by offering strong aid for server-aspect rendering, progressive internet apps, internationalization, and accessibility.

They may be involved in the development of net applications and are determined to fulfill the changing desires of businesses and users in the present-day digital aspect.

VI. Conclusions

In this comprehensive review of JavaScript Frameworks, it represents the evolving panorama of web development. JavaScript, a necessary language, has given uplift to a large number of libraries and Frameworks that help developers create interactive web pages and enhance the overall performance of web packages. Our study of distinguished frameworks like React, Angular, jQuery, and Node.js and emerging frameworks like Vue and Svelte, emphasizes their important role in making the modern web ecosystem.

The important intention of this comprehensive review of JavaScript frameworks is to provide developers and selection-makers a piece of precise information and aid in choosing the most appropriate framework needed and also comparing the frameworks with others to choose the framework that optimizes web development initiatives and forward better knowledgeable technology choices.

Besides, this review paper stresses the importance of choosing the right framework that specifies the specific project's needs, considering factors such as security, server-side rendering, overall performance, developer experience, and community support. JavaScript is continuously evolving so the landscape of frameworks supplies each and every possible demanding situation to the developers. The insights gained from this review serve as an important resource for directing the changing world of JavaScript development, predicting innovations, and assurance of the creation of web studies for worldwide users.

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Certificates

CERTIFICATE OF PRESENTATION & PUBLICATION

Hinweis Second International Conference on Recent Trends in Machine Learning and Image Processing, MLIP–2023

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Author of a Research Paper titled *A Comprehensive Review of JavaScript Frameworks* has submitted the paper which has been approved and presented for publication in the Hinweis Second International Conference on Recent Trends in Machine Learning and Image Processing, MLIP-2023.

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