Chapter-3

Methodology

Chapter 3 provides the detailed explanation of tools and technologies used for the development of mern project.

The MERN stack, comprising MongoDB, Express.js, React, and Node.js, is widely used today due to its ability to streamline the development process by leveraging JavaScript across the entire stack.

**MongoDB:**

MongoDB is a powerful NoSQL database known for its flexibility, scalability, and performance, making it suitable for handling large volumes of unstructured data. Unlike traditional SQL databases that use tables and rows, MongoDB stores data in JSON-like documents, which allows for more complex data structures. Written in C++, MongoDB is an open-source, cross-platform solution that supports dynamic schemas, enabling easy and rapid data integration without requiring predefined structures. Our MongoDB tutorial caters to both beginners and professionals, covering essential topics such as inserting, updating, and deleting documents, querying with various methods, using projection, and applying sort() and limit() operations. Additionally, it guides users on creating and dropping collections, providing practical insights and MongoDB interview questions to enhance understanding and prepare for real-world applications. Whether you are just starting or looking to deepen your knowledge, this tutorial equips you with the necessary skills to leverage MongoDB's capabilities effectively(Javatpoint, 2021) .

**Advantage**(Geeksforgeeks, 2023)

* Schema Not Required: MongoDB doesn’t demand predefined schemas, but schema migration might be necessary for evolving data structures. However, it offers more flexibility than traditional relational databases that strictly require schemas.
* Document Queries: MongoDB’s document-oriented approach aligns with dynamic queries. It allows flexible and varied query operations based on the nature of the documents, unlike static table-based queries of RDBMS.
* Simplified Performance Optimization: Compared to relational databases, MongoDB’s performance optimization is comparatively simpler due to its architecture and the way it manages data internally.
* Efficient Memory Utilization: MongoDB uses internal memory for data storage. So, it accesses the data very fast and enhances the overall performance.
* Horizontal Scaling with Sharding: Using MongoDB, we can horizontally expand our database by distributing data across multiple servers. It is called Sharding. Sharding ensures data separation and even distribution across shards, which is very efficient for data retrieval.
* Ease of Maintenance: MongoDB is generally considered easier to maintain than traditional databases due to its flexible schema and simpler optimization processes.
* Replication and Workload Distribution: By making copies of data and spreading the work across different parts, MongoDB ensures that the information is always available and the system works really fast. This happens because the tasks are shared among many places instead of just one, which makes things quicker and more reliable. The software is included with every computer, eliminating the need to purchase any additional software.

**Express js:** Express is a user-friendly framework that simplifies the development process of Node applications. It uses JavaScript as a programming language and provides an efficient way to build web applications and APIs. With Express, you can easily handle routes, requests, and responses, which makes the process of creating robust and scalable applications much easier. Moreover, it is a lightweight and flexible framework that is easy to learn and comes loaded with middleware options. Whether you are a beginner or an experienced developer, Express is a great choice for building your application.

Key Features of Express

Middleware and Routing: Define clear pathways (routes) within your application to handle incoming HTTP requests (GET, POST, PUT, DELETE) with ease. Implement reusable functions (middleware) to intercept requests and create responses, adding functionalities like authentication, logging, and data parsing.

Minimalistic Design: Express.js follows a simple and minimalistic design philosophy. This simplicity allows you to quickly set up a server, define routes, and handle HTTP requests efficiently. It’s an excellent choice for building web applications without unnecessary complexity.

Flexibility and Customization: Express.js doesn’t impose a strict application architecture. You can structure your code according to your preferences. Whether you’re building a RESTful API or a full-fledged web app, Express.js adapts to your needs.

Templating Power: Incorporate templating engines like Jade or EJS to generate dynamic HTML content, enhancing user experience.

Static File Serving: Effortlessly serve static files like images, CSS, and JavaScript from a designated directory within your application.

Node.js Integration: Express.js seamlessly integrates with the core functionalities of Node.js, allowing you to harness the power of asynchronous programming and event-driven architecture.

### Advantages of ExpressJS:

#### **Minimal and Lightweight**

Express.js is a minimal and lightweight web framework that provides developers with a basic set of features for building web applications. It is designed to be flexible and modular, allowing developers to easily add new functionality as needed. Express.js does not include a lot of unnecessary features, making it fast and efficient.

#### **2. Easy to Learn and Use**

Express.js is easy to learn and use, making it an ideal choice for both novice and experienced developers. It provides developers with a simple and intuitive API for building web applications. Express.js is built on top of Node.js, which means that developers can leverage the power of the Node.js ecosystem and easily integrate with other Node.js modules.

#### **3. Middleware Support**

One of the key features of Express.js is its support for middleware. Middleware is a function that is executed for every HTTP request that is received by the server. Middleware can be used to perform a variety of tasks, such as logging, authentication, and error handling. Express.js provides developers with a wide range of built-in middleware functions, as well as the ability to create custom middleware.

#### **4. Routing**

Express.js provides developers with a powerful routing system that makes it easy to handle different HTTP requests for different URLs. Developers can define routes that map to specific URLs and HTTP methods, making it easy to handle different types of requests. Express.js also supports parameterized routes, which allows developers to handle dynamic URLs.

#### **5. Template Engines**

Express.js supports a variety of template engines, which makes it easy to render dynamic HTML pages. Developers can choose from a variety of popular template engines, such as EJS, Handlebars, and Pug. Express.js also provides developers with built-in support for serving static files, such as images, CSS, and JavaScript.

**Python**: Python is a computer language that is employed to develop software and websites, execute programmes automatically, and analyse data. There is no specific problem that Python is intended to address; it is an all-purpose language. It is employed to produce a variety of programmers. It is a widely used computer language that is simple to learn and can be applied to a variety of applications. Python is frequently employed to develop software and websites, automate tasks, analyse data, and present data visually. Python has been employed by numerous individuals who are not programmers, such as accountants and scientists, for routine tasks such as organising finances, due to its ease of learning.

In his book Python for Everyonebody, Charles R. Severance asserts that "programming is an extremely creative and rewarding endeavour." Severance instructs students at the University of Michigan and on Coursera. "You might write programmes for many reasons, from making your living to solving a challenging data analysis problem to having fun to helping someone else solve a problem." (Cousera, 2021).

**Advantages/Benefits of Python** (Invensis, 2022)**:**

**1. Presence of Third Party Modules:**

The Python Package Index (PyPI) is a comprehensive collection of third-party modules that enables Python to communicate with the majority of other programming languages and tools.

**2. Extensive Support Libraries:**

Python boasts an extensive standard library that includes interfaces for string processes, web services tools, operating systems, and internet protocols. The standard library already includes scripting for a significant number of common programming tasks. This significantly simplifies the process of coding.

**3. Open Source and Community Development:**

Python has been granted an open source licence by the Open Source Initiative (OSI) for the purpose of its development. After that, everyone can use and distribute it, even for business reasons.

The community is also in the position of improving the code because they work on it together at meetings, on email lists, and by providing many modules.

**4. Learning Ease and Support Available:**

Python is an excellent language for learning how to write code because it is simple and easy to understand. Code style standards (PEP 8) are a set of rules that help you handle your code better. A group of working developers and a large number of users have built up a huge library of resources on the internet that have helped the language continue to be used and grow.

**5. User-friendly Data Structures:**

Python has structures for data like sets and lists that can be used to make data structures as rapidly as possible while the programmed is running. In addition to this, Python helps you use "changeable high-level data typing," which means you do not need to write as much support code.

**Django:** Django is a Python web platform that is both open-source and free. Django employs the MVC-MVT architecture pattern to enable users to create websites that are secure, hygienic, and effortless to maintain. It is distinguished from other frameworks by its rapidity, abundance of packages, safety, extensibility, and adaptability.

This framework provides a robust, production-ready automatic management interface that can be utilized to administer the content of your website. It generates a rapid, model-centered interface by extracting metadata from the models, eliminating the necessity of manually adding data.   
Additionally, Django provides support for multiple languages, which can be employed to translate text between them. It also identifies dates, times, numerals, and time zones that are formatted in a specific manner. (Netguru, 2024).

**Advantages of Django:**

**1. Better API**

The Python Django REST Framework tool is designed to facilitate the addition and modification of modules, making it suitable for both basic and complex APIs (Pythongeeks, 2024). It is versatile and includes a built-in browser for testing Application Programming Interface Endpoints.

**2. For Search Engine Optimization**

Companies invest a significant amount of money to enhance their SEO ranking on search engines. Numerous variables contribute to the enhancement of a website's ranking. Keywords are the most critical factor in search engine optimisation, following page launch time. Python is an SEO-friendly framework due to the fact that the majority of its source code is readable by humans. It is simpler for developers to benefit from SEO despite their lack of knowledge about it, as Django includes sitemaps.

**3. CDN**

Many developers who work on large websites that receive a significant number of visitors employ Content Delivery Networks. However, Django is most renowned for its Content Delivery Network Connectivity.

**4. Long-Lasting  Framework**

It was accessible to all. Despite the fact that Django is still in the process of being developed, companies that have implemented it have never transitioned to another framework in search of a superior one.

**5. Ideal for ML Projects**

Python is frequently the primary programming language employed by machine learning scientists. Django's Python framework simplifies the implementation of machine learning applications and models. With the Gunicorn Web Server and Django REST Framework, it is simpler to establish a RESTful API for Machine Learning applications and solutions that are compatible with Python.

**Agile Methodology** (Techtarget, 2023)**:**

Agile is a method of developing software that anticipates the necessity for flexibility and practicality in the delivery of the final product to the consumer. In order to implement agile software development, which emphasises the provision of clean versions of individual software components rather than the entire application, numerous organisations must modify their operational procedures.

Agile offers the advantage of enabling teams to operate in environments that are perpetually evolving while simultaneously emphasising the rapid delivery of business value. Agile fosters collaboration among teams and guarantees that each member comprehends their role in the process. This enhances the organization's overall efficiency. Finally, organisations that implement Agile software development can guarantee that their products are of high quality due to the continuous testing that is conducted. This enables you to notify teams of any potential issues and make modifications as necessary.

Agile is now the primary development method employed by the majority of organisations, as opposed to waterfall. Nevertheless, DevOps is gaining traction and has the potential to supplant or even replace agile.

**The benefits of Agile** (Wrike, 2024)**:**

**1. Satisfied customers**

Agile teams demonstrate their commitment to their customers' perspectives and maintain open communication by allowing them to participate in the development process. Stakeholders desire to be involved in each phase of a project in order to provide feedback and ensure that the final product fulfils their requirements. It is conceivable that these customized deliverables will enhance the overall user experience and encourage consumers to return.

**2. Improved quality**

Agile methodologies employ iterative project management, which involves the improvement of processes with each iteration of an interval. Agile's fundamental principle is that it is imperative to consistently evaluate and enhance the quality of one's work. This facilitates the production of superior products.

**3. Adaptability**

Agile's fundamental principle is adaptability. Agile teams can effortlessly adjust to change, which can occur at any moment. It is effortless for teams to revisit their plans and adjust their priorities to align with new objectives, as project deliverables are not inflexible. Flexibility enables teams to effectively address the evolving requirements of their clients.

**4. Predictability**

Agile teams operate in brief periods of time, which are occasionally referred to as "sprints." Project managers can easily monitor the team's progress and ensure that they have the necessary resources by observing these predetermined intervals, such as two weeks. It is also simpler to estimate the cost of a task over a shorter period of time than over a longer period.

**5. Reduced risk**

Progress is routinely monitored by developers during iterations. This provides them with a more comprehensive understanding of the undertaking and enables them to promptly identify potential issues. It is possible to address these minor issues prior to their escalation. This will set up an effective way to lower risks and increase the project's chances of success.

**6. Better communication**

Agile teams prioritise constant engagement and face-to-face communication. Every day, they typically conduct discussions to ensure that all team members are aligned and working towards the same objectives. Regular communication is maintained to prevent any misunderstandings that could impede their progress towards their objectives.

**Justification:**

The main reasons I selected Python and Django for web programming were their reliability, speed, and simplicity of use. Python is an outstanding choice for writers of all skill levels due to its user-friendly syntax and language. In this way, maintenance and development are more readily skillful. Django, a high-level Python web platform, is equipped with a variety of practical features, including an admin interface, authentication, and object relationship management, in accordance with the "batteries-included" concept. This expedites and facilitates the process of development. Django is founded on three important principles: security, scalability, and the DRY concept. This ensures that applications are scalable, user-friendly, and secure. Python and Django are the most effective languages for developing high-quality, stable web applications due to their intuitive and potent interfaces.

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