



GYM Management System

(ZFit)

Information Technology Project (IT2080)

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Background

Zfit is a comprehensive gym management system developed for ZXCuses Gym in Colombo.

ZXCuses is a modern and customer focused gym which locates in Colombo and plays an important role in health, fitness, mental well-being and personal development through personalized workout plans and modern exercise facilities. As a high-end fitness center, they are committed to providing a supportive and professional environment that inspires individuals to achieve their personal fitness goals. Whether someone is new to their fitness journey or an expert, they offers a wide range of services designed to meet individual needs, placing greater emphasis on both personal physical and mental health, making the gym an essential part of everyday life for many.

They provides members with personal trainers for their individual fitness goals and mental wellbeing. Their certified trainers create structured, result driven programs that help members to train smarter but not harder. Among the services provided by ZXCuses Gym are personalized one-on-one training, senior fitness programs, pre and postnatal sessions, body conditioning, and muscle rehabilitation. Gym includes the latest state of the art fitness machines and technologies which encourage members with their maximum performance and safety. Also, ZXCuses gym go beyond the gym floor with Healthy nutrition plans, and Members can get nutrition and food guidance.

ZXCuses gym continues to rely on manual record keeping and manual management strategies leading to inefficiency in day-to-day business functions. Without a proper system for membership, inventory, reservations, attendance, payment, and schedule management, all members are inconvenienced by delays and errors.

Avoid those challenges, we decided to develop a comprehensive GYM Management System fine-tuned for ZXCuses gym. This System is fully automated with following key functions.

Problem and Motivation

Problem statement

In the finest industry today, gym is finding it harder to efficiently manage its day-to-day operations. These are the challenges which may be affected by their daily operations. It can be both small to Medium sized depend on the manual or semi digital systems such as paper records, spreadsheets, or disconnected software—for managing memberships, attendance, trainer schedules, payments, and fitness tracking. This fragmented process often leads to errors, delays, and poor customer experience.

The existing procedure is too time-consuming for both clients and employees. For instance, when a client signs up, his or her data must be manually entered to billing, attendance, and communication. Trainers find it hard to keep members' plans personal because they do not have centralized access to client data and information. Handling bookings for classes or personal training also can have too much manual coordination. This can lead to results in double booking, missed sessions or customer dissatisfaction. It can be challenging for the growth of each company with other competitors.

There is an increasing demand for gyms to offer such as digital services such as mobile apps, real time updates, online workout plans, and monitoring and tracking progress. Without an efficient gym management system, these services are hard to offer. So, the integrated system should be included with the solutions to prevent these problems. Especially with the competitiveness with the fitness market there is a chance that gyms will lose their members to more tech savvy competitors who can provide a better smoother and enjoyable experience for their customers.

To get more ideas about this, the main problems are:

- Inefficient manual or disconnected systems
- Difficulty in managing client data and bookings
- Limited ability to offer digital services
- Poor user experience and operational delays

These are some matters that hinder a gym's ability to increase their retain members and grow in this fast-paced environment with more efficiency.

Motivations

Having a Gym Management System provides offers many benefits to the gym owners, employees/staff and members of the gym. The motivation of this automate process is to reduce manual workload and increase the overall experience to be improved. It will enhance the user experience as well.

For all the club owners and managers, the system provides centralized management of control over all the principal activities (core activities) membership management, class scheduling, billing and reporting, trainer availability. This automation reduces errors, frees administrative workload and allows the staff to deliver a better service.

Trainers also enjoy and get benefits having live access to member profiles, fitness goals, attendance history and performance data. This gives the chance for them to do better tailor exercise programs and client progress in real time. This improves communication between trainers and members through messages or alerts /notifications.

Members are more convenient and engaged. They have more features like online check-in, class booking, attendance tracking, personalized dashboards, such a system can also allow better experiencing, they gain more control over their fitness journey. A mobile friendly system can also allow receive updates, reminders, and access virtual training plans from anywhere /anytime.

Overall, the Gym Management System addresses important pain points and provides measurable improvements/advantages such as

- Time savings through automation
- Increased accuracy in bookings and billing
- Better data insights for decision-making
- Higher member satisfaction and retention
- Competitive edge in the fitness market

Through this system, a gym can evolve from a traditional gym into a smart, user-centric service provider. It supports current needs, supports, operational needs but it also opens up possibilities and prepares the gym for future development and innovation.

Aim and Objectives

Aim

The main objective of this project is to transform the GYM management system into an efficient and user friendly full featured digital system. The need for such a digital system has arisen due to problems such as manual record keeping and outdated management methods, delays, errors, and the need for telephone or face to face discussions.

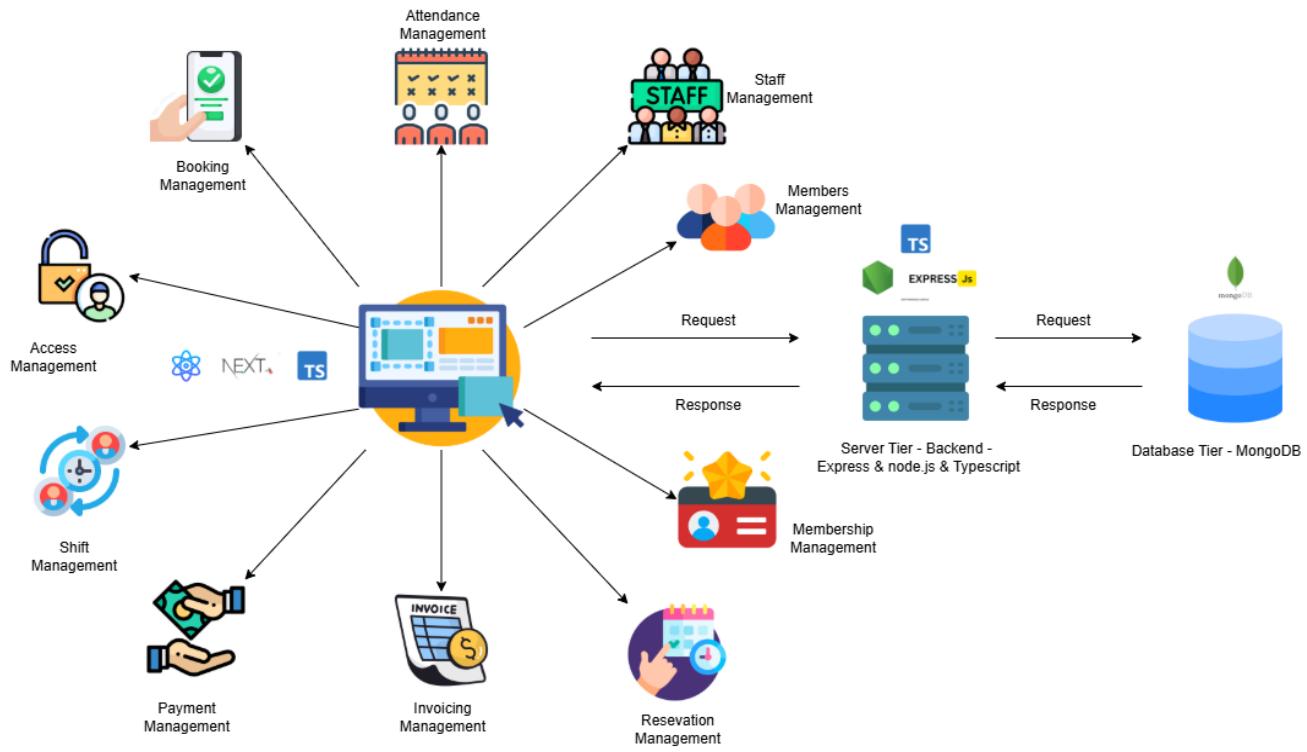
This project is expected to automate the management of the required operations such as member registrations, membership management, employee shift management, staff management, attendance management, resource allocation, payment processing, etc. through a digital system. This system will enable the company to provide systematic, accurate and convenient service to its stakeholders.

This Zero excuses system facilitates this operation by incorporating modern features such as registering attendance through a passcode, secure payments, restricting access to the system based on the role of system users, improving the security and user friendliness of the system, and providing the necessary data for account control, reporting, and decision making.

Objectives

- To develop a user friendly and responsive web application that allows members to register, manage their personal profile, purchase and renew their membership from any device.
- To provide a membership management system that allows the management board to create, update, activate and deactivate membership packages and provide advance notice to members on membership termination.
- To implement a system for collecting member data through a QR code and a manual registration option to ensure accurate and assessed member data is recorded
- To create a system that allows managers to assign shifts and control employee shifts, approve or cancel leave, generate reports and allow employees to track their shifts and request changes.
- Creating a system that allows members to book trainers and facilities and include a mechanism to prevent double bookings
- Incorporating a highly secure payment system with payments by credit debit card, discount codes and automatic receipt issuance
- The system is designed to provide role-based access controls and data security.

System Overview



1. User / Member and Membership Management

The user/member management system and the membership management system is the core of the gym management system. For a high-end gym to function properly this system must work smoothly to increase both customer and staff satisfaction. The goal is to create a secure, reliable and user-friendly system that can be scalable as the gym grows.

Functional Requirements

- The users should be able to register using their information.
- The users should be able to login using their credentials, view and manage their profile.
- The members should be able to browse membership options and subscribe to memberships.

- The members should be able to view their membership status and renew their membership.
- The staff and managers should be able to create member accounts, view and manage their profile.
- The managers should be able to create membership offerings and customize them.
- The managers and staff should be able to see if the members membership subscription has expired.
- Manager should be able to search members and generate member reports.
- The system should create a QR code for each member, store it and display it to the member for attendance and access control.

Non - Functional Requirements

1. Security

- Passwords should be hashed before storing in the database.
- JWT authentication should be implemented for secure authentication and authorization.
- Rate Limiting should be implemented to secure the APIs from DDoS attacks and malicious actors.
- Authentication middleware should be implemented to secure the APIs from unauthorized access.

2. Performance

- System must respond to major requests like login, membership check, registering a member within 2 seconds.
- System should be optimized to handle up to 1000 users.

3. Usability

- The system should be accessible for many devices like desktop pcs, laptops, and mobile devices.

4. Maintainability

- The system should use a simple architecture that can be easily maintained.

- The system should use a language that is type safe for enhanced maintainability (TypeScript).

5. Reliability

- The system should use a language that is type safe for enhanced reliability and production stability (TypeScript).

2. Inventory Control

The Inventory Control function is one of the major functions in Gym management system. This function tracks all the gym equipment and supplements which provides by the gym. Managers and some staff members only have the access to the function, some of the main tasks are record new purchases, monitor stock levels, update item conditions.

Functional Requirements

- The system allows managers to add new inventory items
 - Equipment inventory
 - Supplement stock
- The system allows managers to update inventory details
 - Modifies existing items details
- The system allows managers to remove inventory items
- The system allows managers and staff members to view inventory details
- The system allows managers to generate inventory reports
- The system generates low stock and maintenance alerts

Non-Functional Requirements

1. Usability

- Should be user-friendly to manage the inventory easy manner
- The system should be accessible for many devices like desktop PCs, laptops, and mobile devices.

2. Performance

- Any search or updates should be occurred within 2 seconds.
- The system should be optimized to handle 1000+ items

3.Reliability

- The system should not loss any Inventory data.
- The system should use a language that is type safe for enhanced reliability and production stability (TypeScript).

4.Security

- Only authorized mangers or staff members can have access to the function.

5.Maintainability

- Should be easy to update and maintain without any downtime

3. Payment and Invoice Management

Payment and Invoice Management is the financial component of a gym management system and is responsible for all financial transactions, including invoice generation, payment processing and discounts.

This will allow users to automate membership payments or manage discounts. This is expected to ensure accurate financial records, reduce human errors, and provide customers with a clear understanding of payments.

Member has the ability to view payment history, download invoices, and receive notifications. The goal is to provide users with a convenient and secure billing process and simplify administration.

Functional Requirements

1.Member billing and invoicing generation

- System administrators able to view, edit and manage invoices.
- Each invoice must include;
 - Unique invoice ID

- Member details (name, ID)
- List of service/ products charged
- Total amount (with tax, discounts)
- Due date
- Allow downloading as PDF

2. Payment processing

- Support the following payments methods;
 - Cash, Card payments, Bank Transfers
- Should integrate with payment service providers such as PayHere.
- Support for single payments and online automatic (recurring) payments.

3. Transactions history and receipts

- Members and administrators can view payments history.
- Receipt must be generated after each payment.
- Payments can be filtered by date, service, status.

Non-Functional Requirements

1. Usability

- The system should have an easy, clear interface to use.
- It should be possible to use it on any device.
- It should be easy to search, view, and download invoices.

2. Performance

- Under normal use, invoices and payments should be updated within 2 seconds.
- At least 1000 people can access the system simultaneously.

3. Reliability

- The system should ensure 99.9% availability.
- Invoice and payment data should be recoverable in the event of a disaster.
- The same payment should not be repeated.

4. Scalability

- The system should be scalable with an increase in members.

5. Security

- All data (e.g. card details, invoices) should be kept under encryption.
- Payment records should not be displayed to those without administrative rights.
- Every action should be logged with a user ID.

6. Compatibility

- Should be compatible with the following devices and systems:
 - Windows, macOS, Android, iOS
 - Google Chrome, Firefox, Microsoft Edge
- Should be responsive on any device

4. Member Tracking and Progress Management

This is a part of the gym helping the administrators, trainers and members track and manage their workout routine, attendance and the progress of their fitness. The main goal of this is to make sure that their data is correct, easy to access and helpful to manage and improve personal fitness. This module acts as a main hub of recording gym usage, storing their work out details and track progress toward fitness goals. The checking process stores the update it processes, attendance records in real time. This makes the trainers and administrators see quickly who and how often the members are attending. This history helps to spot trends, for example who declines and busy times which are important for planning and monitoring business.

On addition to tracking the attendance this system records the information of workout as well. Trainers can log into the system and check the number of sets, repetitions, the weight lifted and other performance data. This helps to report the workouts via mobile app. At the end these records will give a detailed explanation about the process each member makes and it easier to adjust training programs for better results.

This function includes some setting features to achieve any goal. By setting personal targets like improving strength, reducing body fat, and then achieving these for a certain level. This progress is tracked and used to record workout and attendance data. These are visualized through charts or graphs. Information is used to depict feedback and create training recommendations.

The system reporting allows administrators and trainers to generate attendance statistics, summary of the performance, progress evaluations for each member of the entire gym. Also, this function supports alerts and notifications to remind the members about any upcoming sessions, workouts or progress milestones, retention and enhancing engagement.

The module also includes all the main features to monitor attendance, workouts and fitness programs in the gym. These functions are built to make it easy to implement in code, using different tools (standard)and databases.

Functional Requirements

1. Member login and profile

Members should log entering using their username and password (ID). After logging they will be able to view their profiles including details such as attendance history, personal information and assigned trainer information.

2. Workout Logging

Members / trainers can record their work out details. Like exercise names, sets, repetitions, used weight, any additional notes will be included in this. This information should be saved in the database their given ID. They can access it for future purposes.

3. Goal Setting and Progress Update

Members can set fitness goals such as “Lose 5kg in 3 months” or “Bench press 80kg.” Trainers can also set goals for members. Progress update can be added manually (e.g. “current weight: 56kg”) and this can save in the database for tracking.

4. History View

Members and trainers should be able to see attendance history, workout history and progress of each overtime. This information can be displayed in charts or tables for better understanding.

5. Trainer Assignment

An administrator should assign a trainer to a member. This link should be saved in the database so both the trainers and members will be able to see who they are working with.

6. Report on Generation

The system should generate sample reports like,

- Member attendance of the last month
- Common workout activities
- Summary of the Goal Progress
- Reports that can be shown on dashboard or exported as any documentation type (PDF, Excel)

7. Notifications and alerts

The system should remind the members about any upcoming news, updates, missing sessions or renewals. Mobile apps or web can be used to appear the notifications or that can be sent as emails.

Non-Functional Requirements

1. Fast updates

All updates attendance workouts, goals should be saved in database within seconds. It will give opportunity to see real-time information to the members and trainers.

2. Easy to Use Interface

The Use Interface should be with clear buttons and forms so it will be easier to navigate. The members and trainers should have the ability to handle the task without any disturbance or confusion.

3. Secure Data Handling

All sensitive data like personal data and health information should be protected using secure connection and encryption. Members are only allowed to watch each data, and the administration has a right to a certain boarder.

4. High Availability

The system should be online at least 99%. It should be able to give access to members and trainers to access information whenever possible.

5. Scalability

The system should have space for more additional members, trainers and locations so it won't need any rebuilding or redesigning. This can be achieved by certain codes and database structures which support growth.

6. Accurate Data

The data should be checked before saving it on system. This would avoid any duplications which can happen and increase accuracy. As an example, if a member already checked in the system should not be created another one.

7. Multi Device Support

The system should work well on phones, tabs, mobile devices and desktops. It has a responsive design that would adjust it to different screen sizes.

8. Maintainability

The code should have comments, variable names that give good documentation. So, it will be easier for developers to understand and update any system changes.

5. Reservation & Booking Management

The reservation and booking management module is intended to automate and simplify the scheduling and distribution of personal training sessions , classes, and GYM amenities in order to avoid double bookings and scheduling conflicts it offers members an easy to use interface that makes it simple to view real time availability make new appointments change existing reservations or cancel them as necessary these reservation may be effectively monitored and managed by gym managers and trainers guaranteeing seamless operation and the best possible use of the facility's resources.

The System also Automation for sending email or mobile alerts which notify users of important information regarding their booking status, upcoming sessions or any changes. This comprehensive functionality enhances member convenience, Optimize the staff workload and improves overall resource management and operational efficiency within the gym environment.

Functional Requirements

- Users can view available gym facilities, classes, and trainer schedules without logging in.
- Users can register and log in using their email and password.
- Logged-in users can book gym sessions, classes, or equipment by selecting a date, time, and resource.

- The system checks existing bookings to prevent double-booking of the same resource and time slot.
- Users can cancel or reschedule their existing bookings from their profile.
- The system displays confirmation messages after successful booking, cancellation, or rescheduling.
- Admin users can view, edit, or cancel any booking in the system.
- Logged-in users can view their full booking history, including past and upcoming bookings.
- Admin users can view basic booking reports such as total bookings, cancellations, and most booked facilities.

Non- Functional Requirements

- **Usability:**

The schedule management system shall allow simple selection of dates and times with the use of drop-down menus; therefore, valid booking slots may be easily picked, Users not registered for the system may still view the schedules but will not be able to make any bookings.

- **Scalability:**

The Reservation modules shall be able to scale up the increasing number of users, resources and bookings as the gym expands.

- **Mobile Responsiveness:**

The system should work well on both desktop and mobile devices, adjusting layout accordingly.

- **Performance:**

The System shall allow bookings and availability updates to be processed in real time without noticeable delay, and the system shall handle at least 50 concurrent users making or managing bookings without performance degradation.

- **Security:**

All Booking actions with role- based access control – Only logged in members can make bookings and Unauthorized booking access or manipulation shall be prevented through input validation and authentication mechanisms.

- **Reliability and Availability:**

The system should be available most of the time, and booking details should be automatically saved in the database to avoid loss due to errors or disconnections.

Literature Review

| Feature | Our Product | Mindbody | Glofox | Zen Planner | GymMaster | Virtuagym |
|------------------------------------|--|---|---|---|---|---|
| Member Portal | <input checked="" type="checkbox"/> (Fully branded portal for registration, profile, bookings, payments) | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Manager Dashboard | <input checked="" type="checkbox"/> (Full control over all the gym functions in a centralized dashboard) |  |  | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |  |
| Member Management | <input checked="" type="checkbox"/> (Comprehensive dashboard for members and staff) | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Membership Management | <input checked="" type="checkbox"/> (Fully customizable membership management with expiry and access control after expiry) | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Reservation and Booking Management | <input checked="" type="checkbox"/> (Ability to reserve any gym resource without conflicts) |  |  |  |  |  |

| | | | | | | |
|---------------------|--|---|---|---|---|---|
| Inventory Control | ✓ | ✓ | ✗ | ✗ | ✓ | ✗ |
| Member Tracking | ✓ | ⚠ | ⚠ | ⚠ | ⚠ | ✗ |
| Progress Management | ✓ | ✗ | ✗ | ✗ | ✗ | ✗ |
| Local Integration | ✓ (local integration with local payment and SMS gateways) | ✗ | ✗ | ✗ | ✗ | ✗ |
| LKR Payments | ✓ (Full support for LKR payments through many local payment methods bypassing huge forex fees and taxes) | ✗ | ✗ | ✗ | ✗ | ✗ |

✓ - Available

⚠ - Partial or Limited Availability

✗ - Not Available

In Conclusion,

There are many similar gym management systems available in the market today. Most of them offer multi-tenant SaaS applications and not tailor made to specific each gym needs. For our literature overview, we compared our solution with the industry leading gym management software according to their features and cost. This comparison helped us to gain insight into each platforms' strengths, identify common limitations and create a solution more suitable toward our client's needs than the alternatives in the current market.

Member and Membership Management

Most alternative gym membership platforms provide the ability for members to register to the gym online, manage their profile, subscribe to memberships and manage their membership. Our system provides a fully branded portal for members to register, manage profile and subscribe/manage their memberships. Our membership management system allows the managers to customize their membership offerings and set restrictions for members that have expired membership plans.

Inventory control

Inventory control in a gym imply tracking, managing, and maintaining all equipment, supplements, uniforms, and other resources to ensure smooth operations. It helps prevent shortages, avoid overstocking, and ensures that machines, weights, and expendable are always available and in good condition for members. Effective inventory control reduces costs, ameliorates efficiency, and supports a better member experience.

Payments, Invoicing and Local Integration Support

All of the systems mentioned in this list are international platforms and they utilize international payments and other third-party solutions when needed for services like accepting payments and sending SMS notifications. Being able to accept payments and pay in Sri Lankan rupees is one of the most important factors in our analysis. So, we have decided to utilize Sri Lankan service providers to handle payments and SMS notification, which in return we can save a lot of money with expensive forex conversion fees and expensive service fees from international service providers.

Reservation and Booking Management System

All the systems mainly focus on class or trainer reservations and there has been a lack of gym resource reservation feature. Our system can handle all those features. But as per client requirement we have also included the ability to reserve and manage other resources gym like boxing ring or treadmills.

Member Tracking and Progress management

The gym member management module helps administrators, trainers, and members track workout routines, attendance, and fitness progress. It records real-time attendance, workout details such as sets, repetitions, and weights, and hold up personal goal setting with visual progress reports. Trainers and administrators can generate performance summaries, spot attendance trends, and adapt training programs for better results. The system also provides alerts and notifications, ensuring members stay engaged and actuated ed while improving overall gym management efficiency..

Methodology

Our project aims to deliver a reliable, scalable and industry ready gym management system that can handle up to 1000 members with no issues. The system will handle major business functions like member & membership, staff & shift management, attendance & access control, payments & invoicing, resource reservation & bookings management and other core features using modern web development technologies, tools and best practices.

Requirement Engineering Methods

To get a better understanding of the requirements of the stakeholders, variety of requirements engineering methods were conducted by us. Through those requirement engineering methods, we have gained insights about the problems with the current system and business functions we have to implement in the new gym management system.

Stakeholder Interviews: -

Interviews were conducted with the managers, staff and trainers to get a better understanding of the difficulties they face with the current system which is a manual record keeping system. These interviews let us get a better understanding of the user requirements and functionalities that needed to be included in our system.

Observation of Current Process: -

The current process which is a manual record keeping method, was carefully observed by our team and we were able to collect impactful information. We were able to identify the systemic drawback of the current system and gained insight on how we can provide a smoother experience for the stakeholders involved.

User Stories and Use Cases: -

To refine the collected data about the user requirements from a user perspective, we used user stories and use case diagrams methods. This way we were able to get a better insight into specific needs and expectations of the users (members, staff and managers). This way we were able to convert the data about real world workflow into well refined business functional requirements.

Alternatives – Surveys, IEEE 830 SRS, MoSCoW prioritization and Kano Model were other identified requirement engineering methods. But for this small-scale project they were too complex and higher time/cost consuming.

Design Methods

- **Wireframing with Figma:** - Used the industry standard UI/UX design tool Figma to design wireframes to design user-friendly user-interfaces.
- **Database Schema Design with Draw.io:** – Entity relationship diagrams were designed for schema planning for MongoDB using draw.io.
- **System Diagram with Draw.io:** - A high level system diagram was designed with major system components and interactions included to better visualize the system's architecture. This process helps the team and the stakeholder better understand the system flow
- **Data Flow Diagram with Draw.io:** - To ensure the proper data handling DFD were used to map how data moves within the system.
Flowchart with Draw.io: - To better understand the sequence of operations and workflow, flowchart was designed.
- **Onion Diagram with Draw.io:** - To better understand the stakeholders and components involved with the system, this diagram was drawn.

Development Tools and Technologies

We have chosen MERN stack for modern industry standard web development in combination with Next.js for better optimized frontend



1. Next.js



Next.js is a React-based framework for building fast, scalable web applications. It offers features like server-side rendering (SSR), static site generation (SSG), API routes, and optimized performance. Ideal for SEO and large-scale apps.

Reference: nextjs.org

2. React



React is a JavaScript library developed by Facebook for building user interfaces. It allows developers to create reusable UI components and manage application state efficiently using a virtual DOM.

Reference: reactjs.org

3. Express.js (ex)



Express.js is a minimal and flexible Node.js web application framework. It simplifies backend development by handling routing, middleware, and HTTP requests. Commonly used in RESTful APIs.

Reference: expressjs.com

4. Node.js



Node.js is a runtime environment that allows JavaScript to run on the server side. It's event-driven, non-blocking, and ideal for scalable, real-time applications.

Reference: nodejs.org

5. MongoDB



MongoDB is a NoSQL database that stores data in flexible, JSON-like documents. It's schema-less, making it ideal for agile development and applications that require scalability.

Reference: mongodb.com

Alternatives – For developing frontend there were many other options such as Vue.js in combination with Nuxt.js. But the bigger community around Next.js and React provided a better support and resources for development. For backend development there were many other good alternatives like Java with Spring boot and PHP with Laravel. But our familiarity with JavaScript based and being able to create the whole application in JavaScript made the developer experience better as well as reduce the complexity of handling different programming languages. So, we chose ExpressJS with NodeJS runtime for our backend. For the database we had two options. No-SQL and SQL databases. But we went with No-SQL database MongoDB because of its simplicity and its flexibility.

Apart from this tech stack we use following tools and technologies in our project.

1. Visual Studio Code (VS Code)



Visual Studio Code is a lightweight yet powerful source-code editor with support for JavaScript, Node.js, and modern frontend frameworks. Its integrated terminal, debugger, and extensions make it ideal for full-stack web development projects like this gym management system. Its speed and customization options make it preferred by many developers (Microsoft, 2023).

Reference: <https://code.visualstudio.com>

2. Git and GitHub



Git is a distributed version control system, and GitHub is a cloud-based platform for hosting and managing Git repositories. Together, they enable team collaboration, version tracking, and seamless code integration. For this project, GitHub supports task management, issue tracking, and deployment pipelines, which streamline agile development processes (Chacon & Straub, 2014).

Reference: <https://github.com>

3. Postman



Postman is an API development and testing tool that simplifies backend and validation. It allows developers to structure, document, and test RESTful API endpoints efficiently. Postman's user-friendly interface and support for collections and environments make it ideal for ensuring the reliability of APIs in the gym management system (Postman, 2024).

Reference: <https://www.postman.com>

4.Tailwind CSS



Tailwind CSS is a utility-first CSS framework that accelerates frontend development by allowing developers to style components directly within HTML. It reduces the need for writing custom CSS and improves design consistency. For this project, it ensures rapid UI prototyping and responsive design, which are essential for member and staff-facing interfaces (Tailwind Labs, 2024).

Reference: <https://tailwindcss.com>

5.PayHere



PayHere is a Sri Lankan online payment gateway that supports card payments, mobile wallets, and bank transfers. It offers secure and easy integration for small businesses. For this gym management system, PayHere is suitable due to its local relevance, ease of use, and support for recurring membership payments (PayHere, 2024).

Reference: <https://www.payhere.lk>

6.Mongoose



Mongoose is an Object Data Modeling (ODM) library for MongoDB and Node.js. It provides schema-based solutions to model data and includes built-in validation, type casting, and business logic hooks.

Reference: mongoosejs.com

7.Jira



Jira is a popular project management tool developed by Atlassian, widely used for tracking tasks, bugs, and project progress, especially in Agile and Scrum environments. It helps teams plan sprints, manage backlogs, and visualize workflows using boards and reports. Jira improves team collaboration, transparency, and productivity by offering real-time tracking and automation features.

Reference: atlassian.com/software/jira

Alternatives – Vanilla CSS is a good option for styling user interfaces. But the better developer experience and usability of Tailwind CSS provides, makes them a better choice for us. For the database handling we could have used the native MongoDB driver. But the additional Object Data Modeling feature of mongoose makes it easier for creating schemas and interacting with MongoDB. For the payment gateway we had few other options like bank payment gateways (commercial bank). But since they had an outdated UI and lack of their integration documentation, we chose PayHere as our payment gateway. For version control there are other alternatives available like GitLab and GitBucket. Since GitHub is the industry standard and ease of use made them a better option for us. Insomnia is another good API testing platform. But as Postman is the more popular among developers because of its powerful feature we decided to go with postman. For our IDE, we considered JetBrains WebStorm and VS Code but ultimately ended up with VS Code for its lightweight UI and millions of plugins support which makes the experience much smoother.

Testing Methods

- **Manual UI Testing** – Manual UI testing is used to conduct the user flows throughout the user interface.
- **Unit Testing with Jest** – Unit testing is used to validate functionality of each component in isolation. This ensures that each function behaves the way it is intended to. Jest is a great tool for testing both frontend and backend logic within the JavaScript ecosystem. This enables us to catch potential issues early on.
- **Integration Testing** - Integration testing is conducted to test the interaction between each component in the system. For testing backend API integration Postman is chosen as it is the industry standard in API testing.

Integration Methods

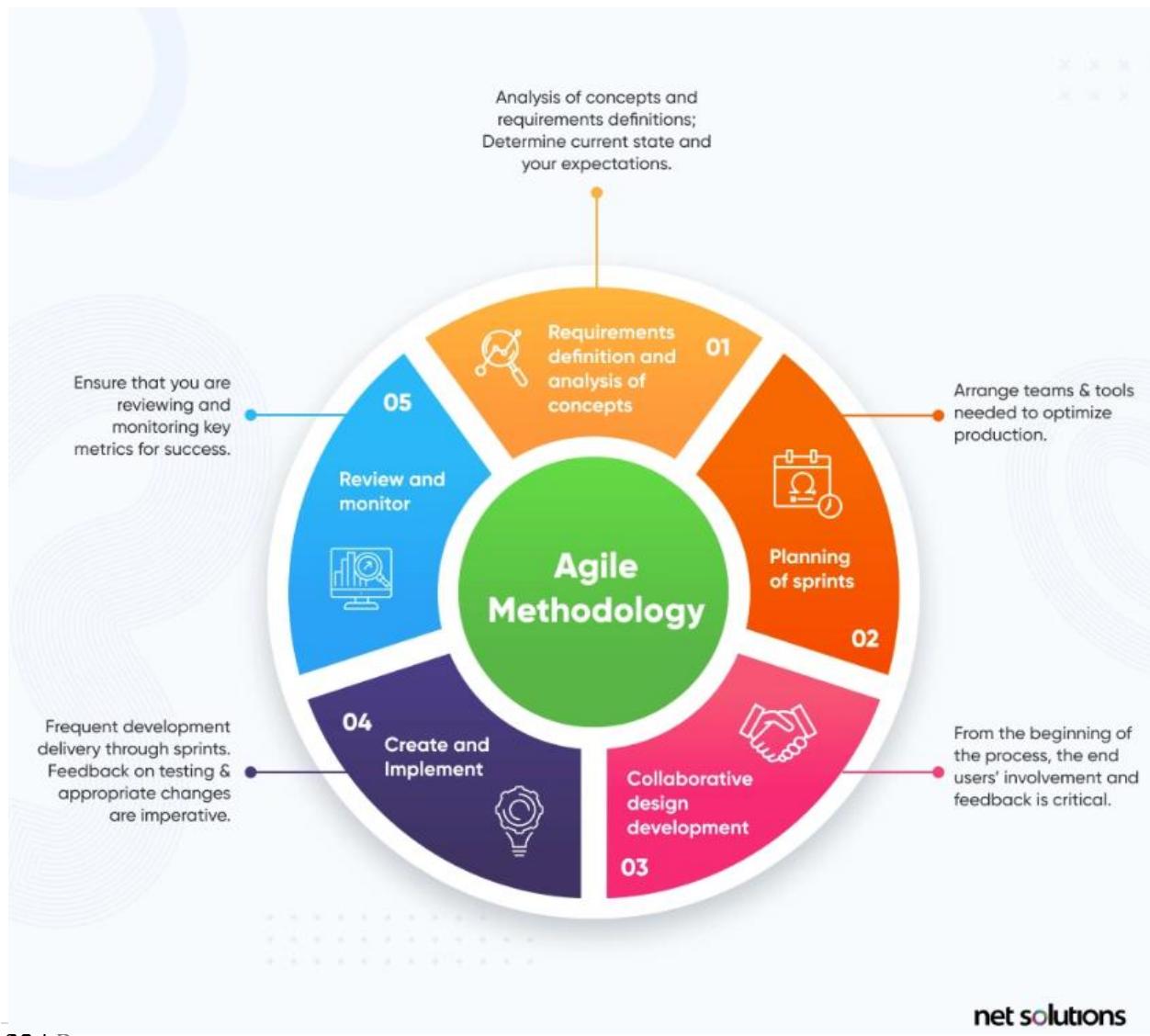
- RESTfull APIs: The core functions of the web application uses RESTfull APIs to communicate with frontend, backend and third-party integrations to fulfill their business functions using GET, POST, PUT and DELETE HTTP request.
- PayHere – PayHere is a Sri Lankan payment gateway providing the merchant to accept LKR payments. It allows us to bypass huge forex fees and taxes added by accepting payments in USD.

Alternatives - For the communication with components we have other options like GraphQL developed by Facebook and gRPC. GraphQL is fast but an overkill for a project this scale. gRPC is a faster internal microservice communication technology. But the added complexity of implementing these technologies made them not suitable for our projects. RESTful APIs make the development architecture simple and reliable.

Agile Software Engineering Methodology

The development of our Gym Management System we were choose the Agile software engineering methodology which helps with our system's incremental, adaptable, and user centric approach. By using this methodology, we can closely collaborate with our stakeholders. This project management approach divides the whole project into smaller phases called sprints, allows feedback and adaption throughout the journey. This iterative technique enhances product quality and decreased the development risk. Great visibility and control were provided to stakeholders throughout the whole project by this Agile methodology.

Tool: - Jira



Work Break-Down Structure

| Week | Phase | Task |
|---------|--|--|
| 01 | Project initialization and requirements gathering. | <ul style="list-style-type: none"> • Stakeholder interviews. • Observation of current process. • User requirement assessment. |
| 02 | Requirement Engineering | <ul style="list-style-type: none"> • User stories and Use case creation. • Identifying core business functions by refining user requirements. • Dividing responsibilities among members. • Choosing a suitable tech stack. • Project proposal creation. |
| 03 - 04 | High Level System Architecture Design and Development Environment setup | <ul style="list-style-type: none"> • Wireframing and UI mockups creation. • Database schema creation and refining. • Creating user workflows. • Creating system diagrams. • Setting up a GitHub repository. |
| 05 - 08 | Development Sprint 1 (Backend Development) | <ul style="list-style-type: none"> • Setting up backend project. • Creating API endpoints for business functions. • Database creation and connecting the database to the application. • Start developing backend. • Applying business logic to the backend. |
| 09 - 10 | Development Sprint 2 (Frontend Development and Integration) and Progress | <ul style="list-style-type: none"> • Progress report generation. • Developing the frontend. • Integrating API endpoints to the frontend. • Developing user interfaces and styling. |
| 11 - 12 | Testing and Optimization | <ul style="list-style-type: none"> • Unit testing and integration testing. • Testing and optimizing the user increasing user experience. • Test application security. • Final report preparation. |
| 13 - 14 | Delivery | <ul style="list-style-type: none"> • Delivering the web application. • Final presentation. |

Evaluation Method

Each module and key area of the system such as User and Membership Management, Payment Management, Attendance and Access Control, Reservation and Booking, and Staff and Shift Management will be thoroughly tested to ensure the overall quality, efficiency, and reliability of the Gym Management System.

Functionality: As a part of functionality testing, unit tests will be run to ensure each module meets its functional requirements including data consistency across modules and validation of workflows.

Usability: User input will be gathered and UX testing to assess the interface's effectiveness and ease of use.

Performance: System scalability and stability will be checked during a peak period.

Security: System will be checked for authorization and authentication processes. The system will also evaluate for common security weaknesses.

Maintenance & monitoring: The system will be monitored and logged to maintain performance and quickly detect any issues. Regular user feedback will be collected to prioritize bug fixes and direct relevant updates and improvements.

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