THOMPSON RIVERS UNIVERSITY

Algorithms & Data Structure (Fall 2023) - SENG 3110

ReStrung - Online Racket String Service

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1 Introduction

“ReStrung”, a pioneering online platform, is on a mission to revolutionize the world of racket sports by connecting racket stringers with passionate players. We understand that the performance of your racket is crucial for your game, and it all begins with the perfect stringing. Whether you're a dedicated tennis, badminton, squash, or racquetball player, finding the ideal stringer can be a challenging task. But with "ReStrung", the search for the right professional becomes seamless.

The aim of our project is to connect racket repair professionals with athletes who need to repair the strings on their rackets. This process would save them the time and money of searching proper repair people through trial and error. In the following report, our engineering design process has been outlined. Firstly, the report breaks down the design problem, laying out the functions, objectives, and constraints of our project. Afterwards, the report explores different solutions, with a brief analysis of the advantages and disadvantages of each solution. Each solution is then weighed out in a decision matrix and the final solution is decided. The final solution is then explored deeper with use case, activity, class and project structure diagrams. These diagrams work to visualize the different components of the system and how they influence each other in the final product. Each project meeting has also been listed, depicting details about what happened in the meeting along with information about when it happened. Afterwards, a section for project management has been outlined, displaying a gantt chart to track our progress throughout the project timeline. Finally, a section has been reserved to enlist and discuss future ideas, and venues to explore related to the project.

"ReStrung", a cross-platform web application, has been designed for ease of use and efficiency in mind. Our user-friendly interface features a filtering mechanism, user search history, and professional recommendations right on the dashboard. With us, you'll have quick and easy access to the experts you need, eliminating the hassle of searching for the perfect repair professional.

Our goal is to simplify the process of finding the right stringer, making racket maintenance hassle-free and accessible. Join us on this exciting journey to redefine the way you experience racket sports. It's time to restring, refine, and redefine your game with "ReStrung".

2 Design Problem

2.1 Problem Definition

One of the most prevalent problems in racket sports occurs when the strings on the racket break. It takes good connections to find a reliable and quick stringer to fix the racket in time. Furthermore, this process can also take multiple days to complete. “ReStrung” aims to address this problem in a fast, reliable, convenient and secure manner. The ReStrung Web Application will bridge the gap between athletes and stringer to provide a “one-stop shop” for any and all kinds of racket stringing service. The application also aims to verify the string repairs through customer verification. Each string repair specialist will also be verified by an in-house checking team before they are allowed to receive orders from customers.

2.2 Design Requirements

2.3

2.3.1 Functions

1. **ReStrung must allow the users (athletes) to register their account and create a customer profile**
    - Allow athletes to create personalisable accounts, manage these accounts, and input and store relevant information such as location, contact details, and preferences.

2. **ReStrung must have a Filter Mechanism**
    - Allow athletes to filter through stringers near them. The search results should offer additional information about the professionals such as areas of expertise, previous work samples, ratings, and reviews. This will help the athlete make their selections based on objective evidence, allowing for a greater user-connected experience.

3. **ReStrung must allow the Service Provider (stringers) to register their account and create a customer profile**
    - Allow stringers to create personalisable accounts, manage these accounts, and input and store relevant information such as location, contact details, previous work samples, and areas of expertise within racket sport(s).

4. **ReStrung must allow for Communication between the Service Provider and Athletes**

- Allow athletes and service providers to seamlessly communicate through a web-app messaging system.

5. **ReStrung must allow for Booking and Scheduling of stringing services through the app**

   - Allow athletes to book and schedule their repairs from within the app. The app will allow professionals to set availability and will provide athletes with the option to choose a time to book an appointment.

6. **ReStrung must allow customers to rate the quality of service of the stringers**

   - Allow athletes to leave reviews on stringers' pages post-repair, including the capability to post pictures and/or videos. This helps in fostering transparency and accountability in the community.

7. **ReStrung must allow for a specific notification systems on both the stringer and athlete sides**

   - Both users will receive a notification as a reminder for the repair, as well as user-specific notifications. These user-specific notifications will consist of the stringer getting a notification as the athlete arrives, and the athlete will receive ongoing notifications as the job processes.

8. **ReStrung must allow users to provide feedback to the web-application developers**

   - Both the athlete and service provider can provide feedback to the developers through the web-app feedback system.

2.3.2 Objectives

1. **ReStrung should load and display results fast**

   - Implement efficient search algorithms and data structures for optimal matching, operational costs, and server load.

2. **ReStrung should have a positive impact on the racket sport community**

   - create a community that positively impacts local talents and independent stringers

3. **ReStrung should have a user interface that is aesthetically pleasing**

   - should have an optimized UI/UX for users to interact with, along with a pleasing colour and layout scheme.

4. **ReStrung should be scalable**
    - should be able to scale to accommodate for any potential increase in customers
5. **ReStrung should store user data safely User data**
    - User data is adequately stored and not subject to memory leaks

2.3.3 Constraints

1. **Political/Safety Constraints**
    - Software must comply with general laws
    - Software must adhere to ethical practices
2. **Quality Constraints**
    - Stringing services must follow safety protocols and standards
3. **Budget Constraints**
    - Software must not spend money to develop
4. **Socio-economic constraints**
    - Users of the software must have basic logic skills and be able to read and write English in order to input queries and searches.

3 Solution

3.1 Solution 1

The initial solution proposed for this project was to utilize React Native, a popular framework known for its ability to enable cross-platform compatibility, which allows the web application to seamlessly function on both iOS and Android devices. This approach significantly reduced the complexities associated with building separate native applications for iOS and Android. React Native possesses the convenience of supported databases (e.g. SQLite, Realm, Firebase), making the data easy to insert and read from within the main program. The database containing information on stringers can be extracted and organized using sorting algorithms, which are then displayed on the user interface in an aesthetically pleasing manner. Stringers can then be communicated with by a customer (e.g. email) and an appointment would be scheduled.

However, it's important to note that React Native, while efficient, relies on JavaScript as its primary programming language. This posed a potential challenge, especially for developers who were unfamiliar with the language. JavaScript, although widely used and versatile, does have a learning curve, particularly for those transitioning from other programming languages. Given the limited timeframe of this project, the unfamiliarity with JavaScript among team members would likely lead to a prolonged duration for adapting to the language's nuances and best practices. This barrier within this implementation would lead to a poorer overall product compared to the other solutions.

3.2 Solution 2

ReStrung’s second advanced solution was to utilize the Django framework. This framework is a free and open-source Python-based web framework which is known for its robustness and rapid development capabilities. This framework was intended to streamline the development process as well as maintain the scalability of the ReStrung architecture. For the databases, Django officially supports PostgreSQL, MariaDB, MySQL, Oracle, and SQLite, however for ReStrung we would be using PostgreSQL. This relational database management system (RDBMS) is also open source and it is known for its reliability and extensive support for complex queries. In addition one of ReStrung’s utmost priorities would be our users' privacy and safety, which is yet only another reason to use PostgreSQL. Django also provides a built-in Object-Relational Mapping (ORM) to interact with the database seamlessly which will be very helpful in creating search and filter mechanisms, messaging and communication functionalities, booking and scheduling capabilities, a notification system, as well as a rating and review system. To enhance ReStrung’s user experience we will take advantage of Django’s aesthetically pleasing user interface. This will allow ReStrung to have the potential to flourish without having to worry about scalability. ReStrung is also compliant with general laws and ethical practices, with implemented safety protocols and guidelines users within the application to guarantee the safety of both users and

service providers. Although PostgreSQL is an open-source RDBMS that is strong and dependable, there are a few possible drawbacks. These include the complexity of its setup, which may call for more knowledge, and its resource-intensive nature, which may affect overall performance, particularly during moments of high traffic. Despite these factors, ReStrung is committed to overcoming these obstacles by rigorous optimisation and effective resource management, guaranteeing a smooth and effective user experience. ReStrung is dedicated to putting strong security measures in place to protect user data and maintain the highest standards of data protection and integrity, with a focus on user privacy and safety. In conclusion, ReStrung gains a strong and scalable platform for platform development, as well as a safe and intuitive user experience, from the combination of Django with PostgreSQL as the RDBMS. ReStrung is well-positioned to change the racket sports scene by bringing players and qualified repair experts together and building a trustworthy community with a focus on user privacy and frictionless database interactions.

3.3 Final Solution

ReStrung's third alternative solution involves leveraging the Django framework, similar to the second option, to streamline the development process and maintain the scalability of the ReStrung architecture. However, in this approach, we'll opt for SQLite as the relational database management system (RDBMS) instead of PostgreSQL. SQLite, like PostgreSQL, is open source and renowned for its reliability. While it may not have the same level of robustness and scalability for handling complex queries as PostgreSQL, it offers certain advantages, especially in terms of its lightweight and easy setup. This may lead to reduced resource consumption, making it a suitable choice, particularly during periods of high traffic. This will also be more suitable for the scope of the project, given the expertise of the programmers. Just as with PostgreSQL, Django provides a built-in Object-Relational Mapping (ORM) system that seamlessly interacts with the SQLite database. This ORM will be invaluable in creating various features such as search and filter mechanisms, messaging and communication functionalities, booking and scheduling capabilities, a notification system, as well as a rating and review system. ReStrung can still take advantage of Django's aesthetically pleasing user interface, ensuring a visually appealing platform for users. Moreover, ReStrung remains fully committed to implementing rigorous optimization and efficient resource management to address any potential performance issues associated with SQLite, ensuring a smooth and effective user experience. ReStrung maintains its dedication to strong security measures, data protection, and user privacy, irrespective of the database choice. Safety protocols, guidelines, and privacy concerns are all paramount within the application to guarantee the safety of both users and service providers. In summary, by combining the capabilities of Django with SQLite as the RDBMS, ReStrung still possesses a strong and scalable platform for platform development, as well as a safe and intuitive user experience. This approach provides an alternative option, emphasizing efficient

resource usage and quick setup, making it suitable for a wide range of users interested in racket sports.

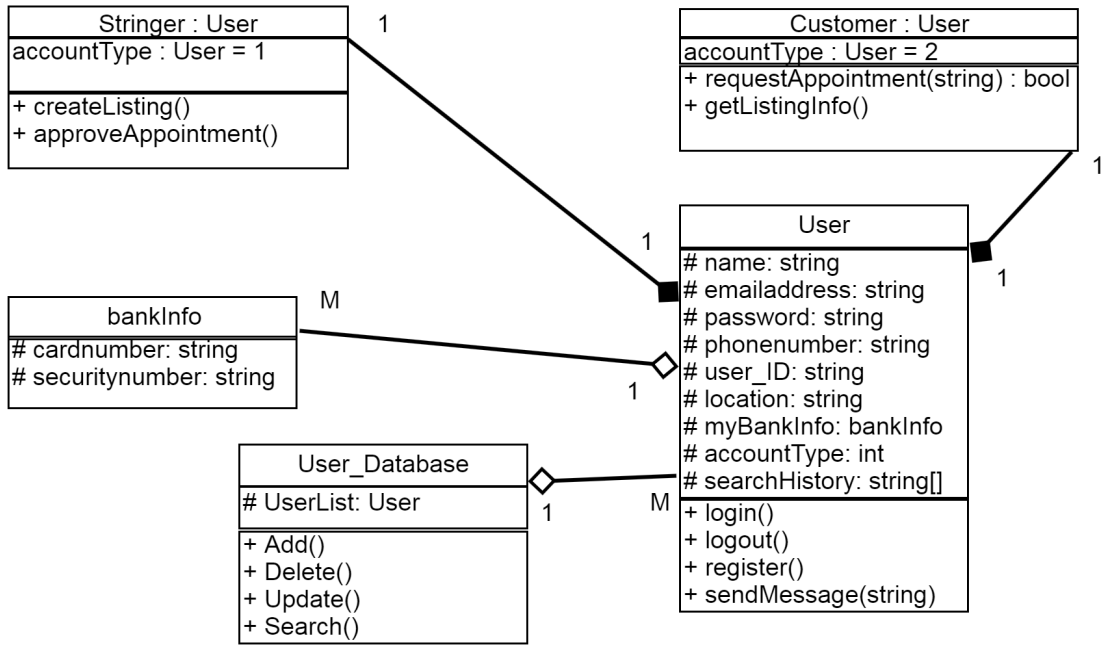


Figure 1: Class diagram of proposed model.

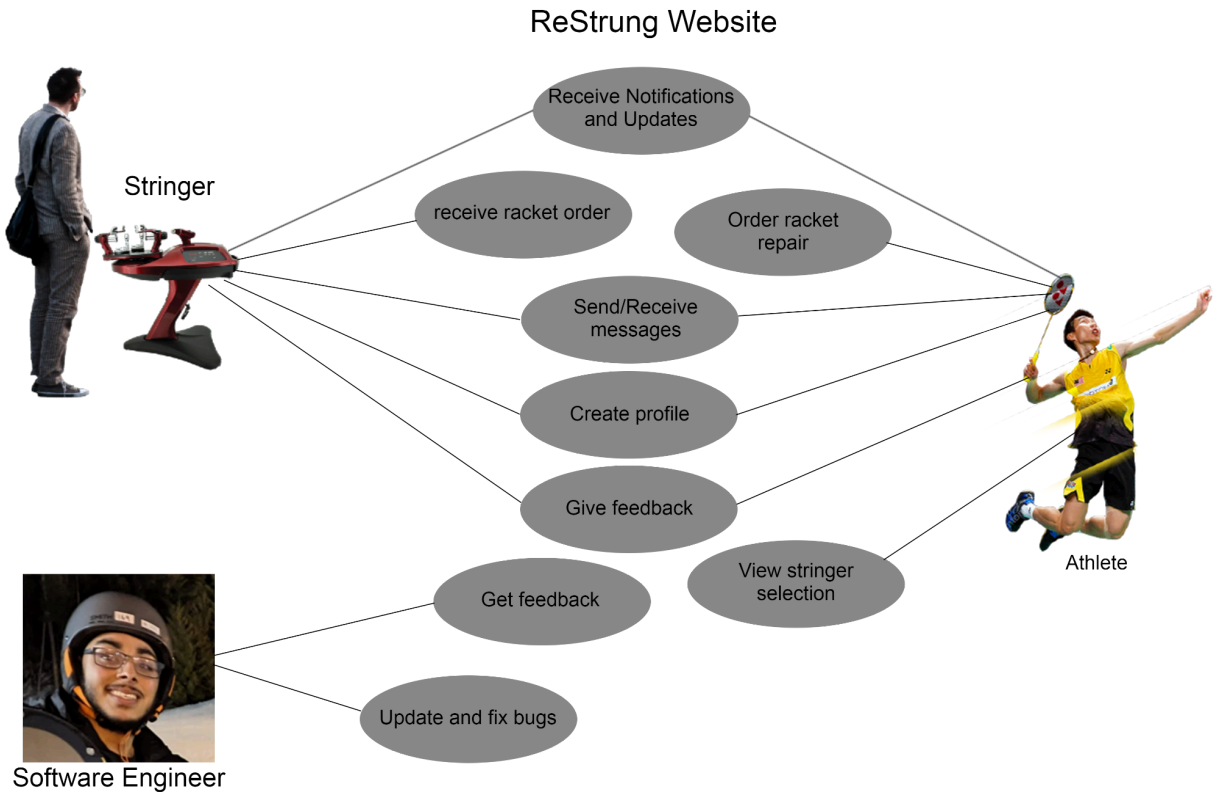


Figure 2: Use Case of Project

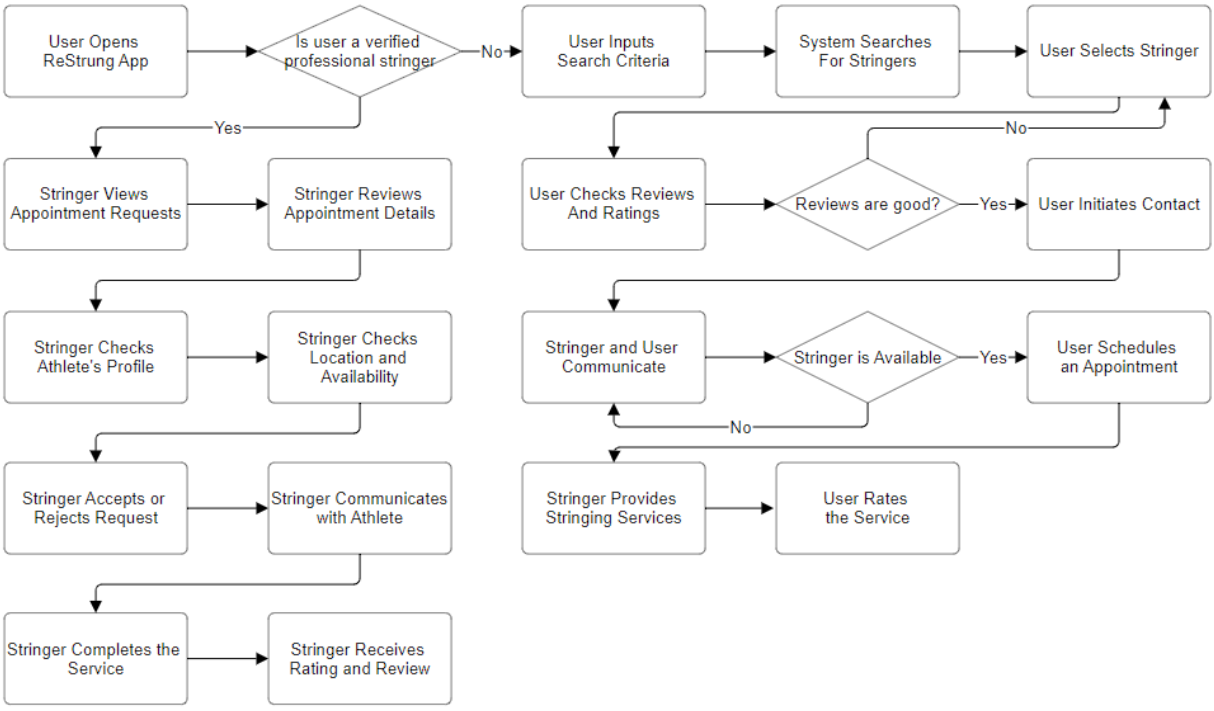


Figure 3: Activity Diagram for proposed diagram

Table I Decision matrix chart for the considered alternatives

		Solutions					
		Solution 1		Solution 2		Final Solution	
Criteria	Weight	Score	Partial Score	Score	Partial Score	Score	Partial Score
Aesthetic	0.40	6/10	0.240	6/10	0.240	7/10	0.280
Efficiency	0.25	3/5	0.150	4/5	0.200	5/5	0.250
Scalability	0.20	9/15	0.120	12/15	0.160	9/15	0.120
Ease of Implementation	0.15	9/10	0.135	6/10	0.090	8/10	0.120
Sum	1.00		0.645		0.690		0.77

3.3.1 Features

- **Rating System:** Users will be given the ability to rate stringers based on the quality of work received from the stringer. This may simultaneously improve the service of the stringer as well as display the collective opinion of other users' experience.
- **Advanced boolean search:** The search functionality includes advanced Boolean operators (AND, OR, and NOT) to enhance the precision of search results, allowing users to customize their search queries.

- **Search history:** The app keeps track of users' search history, making it convenient for them to review past searches and easily find previously viewed stringers.
- **Search and filter system:** Allows the user to refine their search to find the stringers that meet their requirements. The use of efficient sorting algorithms will make this search quick and efficient.
- **Messaging System:** Users can contact their desired stringers to make an appointment through the messaging system.
- **Notification System:** Informs the stringer and user of the appointment details as not to forget their schedule.
- **Web Application Feedback:** Users will be allowed to provide feedback on the web application itself to better its features.

3.3.2 Environmental, Societal, Safety, and Economic Considerations

- **Environmental Considerations**
  - ReStrung aims to ensure a positive ecological footprint through the usage of digitalization, minimizing our paperwork and printed documents, efficient resource utilization, which entails optimizing our algorithms and data structures to reduce server load and energy consumption, as well as efficient scheduling to optimize travel routes and minimize carbon footprints.
- **Societal Considerations**
  - ReStrung aims to foster a sense of support and recognition for skilled stringing professionals as well as promote a sense of community amongst racket sport athletes and professionals. Our platform will emphasize safety protocols and ethical practices to maintain a culture of trust and accountability in the racket sports community.
- **Safety Considerations**
  - ReStrung aims to develop and maintain a safe community through the use of our many methods. We aim to verify every stringer and validate their expertise and credentials in order to ensure the quality of their services. ReStrung will also ensure protected communication channels and user data in order to preserve user privacy and integrity.
- **Economic Considerations**
  - ReStrung will promote local companies and entrepreneurs and increase economic activity at the community level by bringing together athletes and stringing professionals in the area. Within the racquet sports service industry, the platform's effective booking and scheduling features will maximise resources and boost transaction volumes. Furthermore, a greater user base might be drawn in by the legitimacy and confidence created by user verification, which fosters economic expansion. Additionally, the platform's feedback culture can foster

innovation, which could result in the launch of new services and wider diversification of the sector, ultimately boosting its economic health.

3.3.3 Limitations

1. **Limited user base:** The web app's effectiveness relies on the availability of both racket stringers and people who will use their service. If there is a limited number of stringers or customers in a specific area, the web app's utility may be constrained.
2. **Reliability of Information:** The accuracy of information provided by stringers (such as qualifications, experience, and reviews) may be misleading or false information that could lead to mismatched expectations and negative user experiences.
3. **Quality Control:** Ensuring consistent quality of stringing services across various stringers is essential. Lack of standardized procedures or quality control measures could lead to varying experiences for users.
4. **Technological Barriers:** Users need access to a computer or smartphone with an internet connection to use the platform. People without these technological resources might be excluded, limiting the platform's accessibility.
5. **Competition:** There might be existing competitors or traditional methods of finding racket stringers, such as local sports stores.

4 Team Work

4.1 Meeting 1

Time: September 29, 2022, 10:00 am to 11:00 am

Agenda: Complete Introduction, Design Requirements

Team Member	Previous Task	Completion State	Next Task
Harsh Sarvaiya	Introduction & Problem Statement	100%	Document Polishing
Toshiro Turner	Objectives, Constraints	100 %	Solution 1 & Features
Ekam Taneja	Document Polishing, Functions, Constraints	100%	Solution 2, Functions, Document Polishing

4.2 Meeting 2

Time: Nov 1, 2023, 6:30 pm to 8:25 pm

Agenda: Polish document based on Feedback, Rough Draft Solution 1 and 2

Team Member	Previous Task	Completion State	Next Task
Team member 1	Document Polishing/ Fix Feedback	100%	Use Case Diagram, Solution 3
Toshiro Turner	Solution 1 & Features	100%	Class Diagram, Limitation
Ekam Taneja	Solution 2, Functions, Document Polishing	100%	Considerations, Activity Diagram

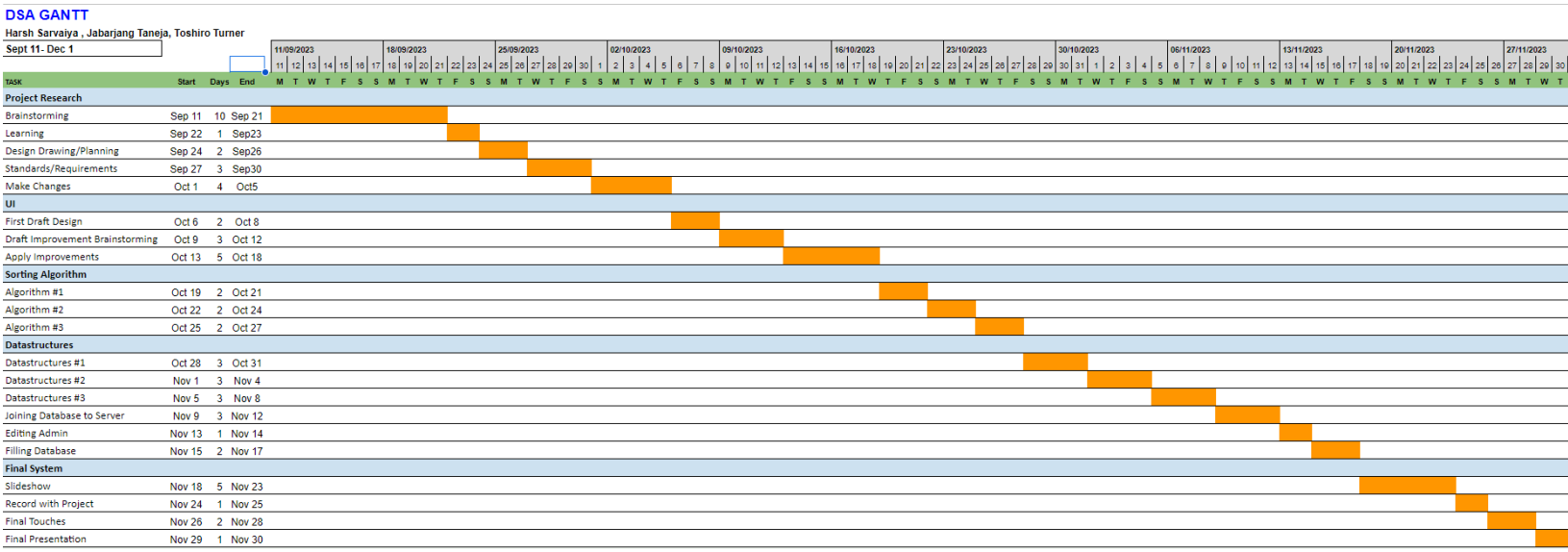
4.3 Meeting 3

Time: Nov 3, 2023, 5:30 pm to 9:30 pm

Agenda: Solution 3, Considerations, Limitations, and diagrams for solution

Team Member	Previous Task	Completion State	Next Task
Team member 1	Use Case Diagram, Solution 3	100%	Task 1, Task 5
Toshiro Turner	Class Diagram, Limitation	100%	Class Diagram
Ekam Taneja	Considerations, Activity Diagram	100%	Task 6

5 Project Management



Link to Gantt Chart: Gantt Chart for DSA

6 Conclusion and Future Work

ReStrung has successfully created a cross-platform web app connecting racket stringers and players, achieving:

Design Functions:

- User Registration and Profiles: Seamless account creation and management for athletes and stringers.
- Filter Mechanism: Efficient search based on proximity, expertise, ratings, and reviews.
- Communication: Real-time messaging between athletes and stringers.
- Booking and Scheduling: Hassle-free appointment setup within the app.
- Rating and Reviews: Transparent feedback system for users.
- Notification System: Timely reminders and updates for both parties.
- Feedback Mechanism: Direct input channel for users.

Design Objectives:

- Fast Loading and Display: Optimized algorithms for quick results.
- Positive Community Impact: Fostering a supportive community for local talents.
- Aesthetically Pleasing UI/UX: User-friendly interface with pleasing design.
- Scalability: Built to accommodate potential customer growth.
- Secure User Data Storage: Ensured safe data storage with no memory leaks.
- Compliance with Laws and Ethics: Adhering to legal and ethical standards.
- Safety Protocols: Following safety standards for stringing services.
- Budget Adherence: Developed within budget constraints.

Recommendations for Future Design:

- Enhanced Database Management: Explore advanced systems for improved scalability.
- Machine Learning for Recommendations: Personalized suggestions for users.
- Globalization and Language Support: Multi-language support for a diverse user base.
- Advanced User Analytics: Deeper insights into user behavior and preferences.
- Community Engagement Features: Forums, events, or challenges for user interaction.

7 References

[1] “Django,” Django Project, https://docs.djangoproject.com/en/5.0/.
[2] Mobile-Shell, GitHub, https://github.com/mobile-shell/mosh.

8 Appendix