

# **IR-SEE**

## **(IMPROVING READING SPEED WITH EYE EXERCISES)**

IZMIR UNIVERSITY OF ECONOMICS

SE216 PROJECT FINAL REPORT

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## INTRODUCTION

Many people today have a variety of problems such as low reading speed, reading comprehension difficulties, focusing problems, time management problems and lazy eyes. These conditions can affect our daily lives and reduce our productivity. These problems are becoming more evident, especially with the intense work pace brought about by modern life and the increase in digitalization. Within the scope of this project, it was aimed to increase reading speed with various exercises suitable for all age ranges and reading skills. With various eye exercises such as dot tracking, zigzag eye exercises, square visual field exercises, hourglass exercises, it was aimed to enable people of all age groups to use their time for reading more efficiently and to increase their comprehension rates. In order to monitor this goal, at the beginning and end of each level, the user was given the appropriate text and the increase in the number of words read per minute was observed and recorded. The level of these exercises was adjusted according to the user and exercises that became more comprehensive as they progressed were designed. It was also supported with appropriate exercises to minimize the problem of lazy eye.

## OBJECTIVES

The objective of this project is to create a platform that simulates various reading exercises to improve reading speed and comprehension for all age groups. It is more effective for users to experience interactive exercises rather than just reading about them. This platform will include:

- To give reading habits to children who are new to reading
- Increasing the reading rate among adults
- Increase reading speed
- Increasing reading comprehension
- Minimizing lazy eye and similar problems

## PROJECT REQUIREMENTS

The platform "IR-SEE (Improving Reading Speed with Eye Exercises)" is designed to help users enhance their reading speed through various eye exercises. The system includes functionalities for user authentication, exercise tracking, and personalized recommendations. The following sections outline the functional and non-functional requirements of the platform.

### Functional Requirements

- **Access to Features:** The user should be able to access all kinds of exercises, profile settings, and results from the menu section on the side of the platform's interface.

- **User Authentication:** Users should be able to create accounts and log in securely to the platform.
- **Profile Management:** Users should be able to update their profiles and personal information.
- **Language Selection:** Users should be able to choose their preferred language.
- **Exercise Selection:** Users should be able to choose exercises suitable for their age group and specific goals (e.g., increasing reading speed, improving focus, preparing for exams).
- **Progress Tracking:** The platform must track users' progress through exercises, time spent, and performance improvements.
- **Adaptive Difficulty:** Exercises should be adjustable based on the user's skill level and progress, increasing in difficulty as the user improves.
- **Variety of Exercises:** The platform must include various eye exercises such as dot tracking, zigzag eye exercises, and square visual field exercises to enhance reading speed and minimize lazy eye problems.
- **Multilingual Content:** Users should have access to content in multiple languages, allowing them to practice reading and comprehension skills in different languages.
- **Daily Reminders:** The system should send daily reminders to users to build a habit.
- **Comprehension Measurement:** The platform should measure the users' comprehension levels both before and after exercises to evaluate the effectiveness of the program.
- **Reading Speed Measurement:** The platform should measure the user's reading speed using eye tracking.
- **Personalized Recommendations:** The platform should provide personalized recommendations based on the user's performance and preferences to enhance their learning experience.
- **Detailed Progress Reports:** Users should receive detailed progress reports, including metrics on reading speed improvement, comprehension rates, and any changes in focus or eye health.

## Non-Functional Requirements

- **Performance and Responsiveness:** The platform must be responsive and performant, even under heavy user load, to ensure a smooth user experience.
- **Data Security:** User data must be securely stored and transmitted to protect users' privacy and sensitive information.
- **Accessibility:** The platform should be accessible to all users, following accessibility guidelines to ensure inclusivity.
- **Ease of Use for Disabled Users:** The platform should be easy to use for people with disabilities.
- **Compatibility:** The platform should be compatible with various devices and operating systems to reach a broader audience.
- **Scalability:** The system should be designed to handle a growing number of users and exercises without a significant decline in performance.
- **User Interface:** The user interface should be intuitive and easy to navigate, welcoming to users of all ages and skill levels.
- **Reliability:** The platform should be reliable, with minimal downtime and robust error handling mechanisms in place.
- **Multilingual Support:** The platform should support multiple languages both in the user interface and in the content provided to users.
- **Data Backup and Recovery:** Regular backups of user data should be performed, and mechanisms for data recovery in case of system failure should be in place.
- **Regulatory Compliance:** The platform should comply with relevant regulations and standards, particularly regarding data protection and user privacy.
- **User Feedback Integration:** The platform should receive feedback from the user at regular intervals and develop the platform accordingly.

## PROCESS MODEL

For the "IR-SEE (Improving Reading Speed with Eye Exercises)" project, we chose Scrum as our development methodology due to several compelling reasons that align well with the project's requirements and goals.

### Iterative and Incremental Development

Scrum's iterative and incremental approach was perfect for developing a platform with multiple complex features, such as eye tracking, user authentication, and personalized exercise recommendations. By breaking down the development process into manageable sprints, we could focus on delivering small, functional increments of the platform, allowing us to gather feedback and make improvements continuously. This approach ensured that we stayed aligned with user needs and project goals throughout the development cycle.

### **Transparent Progress**

One of the core principles of Scrum is transparency. With regular sprint reviews and daily stand-ups, all team members, including stakeholders, had clear visibility into the progress of the project. This transparency was crucial for a project involving multiple components like GUI design, database management, and user tracking.

### **Suitable for Making Changes**

The ability to adapt to changes is a significant advantage of Scrum. Given the dynamic nature of our project, where user feedback and evolving requirements could lead to changes in features or functionalities, For instance, if user testing revealed a need for a different type of eye exercise or a new way to measure reading speed, we could easily incorporate these changes in subsequent sprints without disrupting the overall project timeline.

### **Long-Term Maintenance and Evolution of the Platform**

Scrum's focus on continuous improvement and iterative delivery aligns well with the long-term maintenance and evolution goals of the IR-SEE platform. By continuously integrating user feedback and making incremental improvements, we can ensure that the platform remains relevant and effective in improving users' reading speeds. This approach also facilitates easier maintenance and updates, as changes are made progressively rather than in large, disruptive batches.

### **Reducing Risks with Early Identification**

Scrum's emphasis on early and frequent testing helps in the early identification and mitigation of risks. In a project like IR-SEE, where user satisfaction and functional accuracy are critical, identifying potential issues early in the development process is crucial. Through regular sprint reviews and retrospective meetings, we could detect and address problems early, thereby reducing the risk of significant issues arising later in the project.

In summary, the decision to use Scrum for the IR-SEE project was driven by its alignment with our project's needs for iterative development, transparent progress tracking, flexibility in handling changes, long-term platform maintenance, and risk reduction. Scrum's framework allowed us to create a dynamic, user-focused platform capable of evolving and improving based on continuous feedback and real-world use.

## **SOFTWARE TOOLS**

For our project, selecting the right software tools is crucial to facilitate the development, management, and execution of various tasks. These tools provide our developers with the necessary functionalities and features to streamline workflows, enhance productivity, and ensure the successful completion of our project objectives. Each tool has been carefully chosen to address specific needs within our project, including database management, authentication, and deep learning.

### **Tool for Database:**

After careful consideration, Firebase was chosen over other options such as Microsoft Azure and Amazon Web Services (AWS) due to several key factors. Firstly, Firebase offers a significantly shorter training period, making it more accessible for our team to quickly become proficient. Secondly, we have prior experience with Firebase's ecosystem from previous database tasks, which further streamlined our integration process.

Moreover, Firebase provides a high level of functionality at a competitive price, ensuring we can maximize our project budget without compromising on features. The platform's ease of use and tools tailored specifically for mobile and web development played a crucial role in our decision. Additionally, being a Google-backed service, Firebase ensures reliability and continuous innovation, which are vital for the sustainability and growth of our project. In contrast, while Azure and AWS offer extensive features, Firebase's targeted capabilities and user-friendly environment made it the optimal choice for our needs.

## SOFTWARE TOOLS FOR TASK 2:

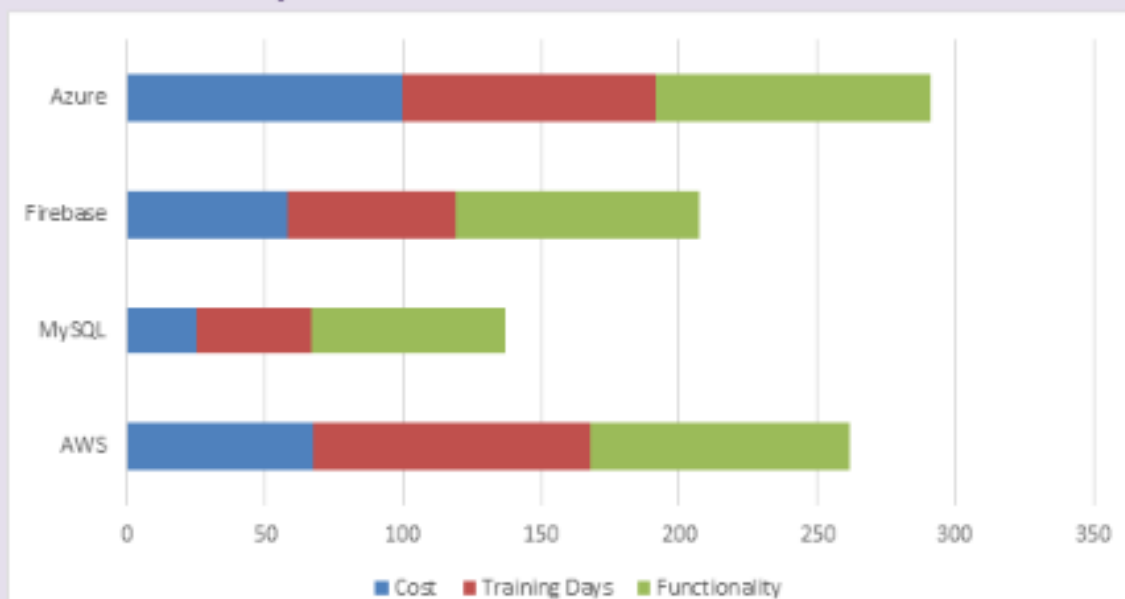
Tool Cost/Training/Functionality Data

Tool	AWS	MySQL	Firebase Realtime Database	Azure
Cost	400\$	150\$	350\$	600\$
Training Days	23	10	14	21
Functionality	80	60	75	85

Normalized Cost/Training/Functionality Data

Tool	AWS	MySQL	Firebase Realtime Database	Azure
Cost	67.7	25	58.3	100
Training Days	100	41.6	60.8	91.3
Functionality	94.1	70.6	88.2	100

Normalized Tool Graph

**Tool for Authentication:**

For our authentication needs, Firebase was again the preferred choice. The decision was influenced by the fact that Firebase's authentication tools are seamlessly integrated with its other services, providing a cohesive and streamlined workflow. The platform's robust security features, ease of implementation, and comprehensive documentation allow our development team to efficiently manage user authentication processes. Firebase's authentication service



supports multiple authentication methods, including email and password, social media logins, and phone authentication, which enhances the flexibility and security of our application.

#### SOFTWARE TOOLS FOR TASK 1:

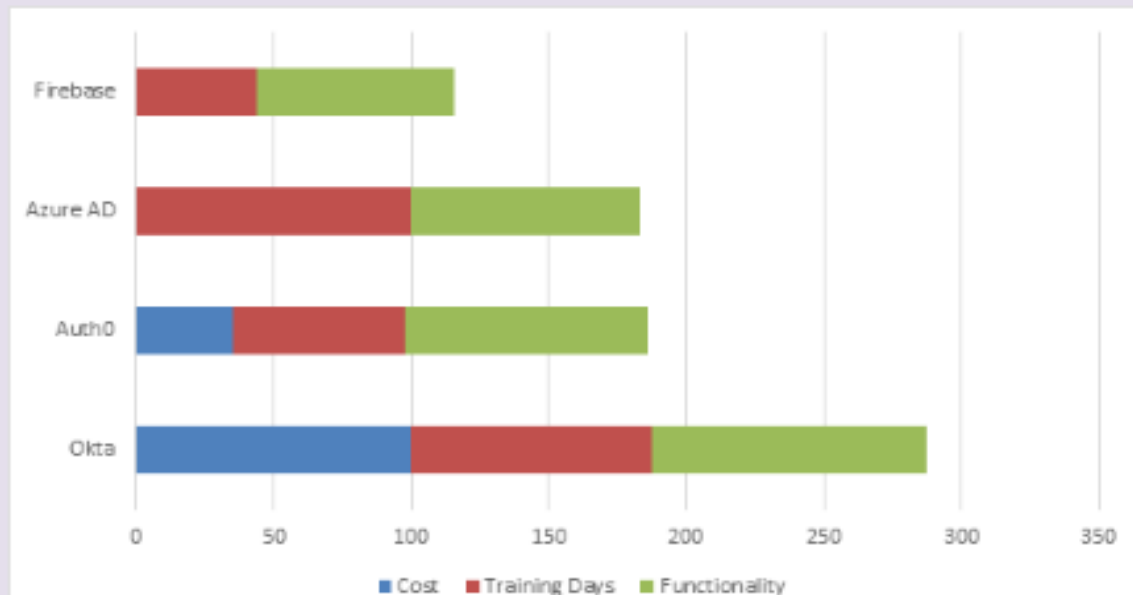
##### Tool Cost/Training/Functionality Data

Tool	OKTA	AUTH0	Azure Active Directory	Firebase Authentication
Cost	\$4000	\$1400	\$0	\$0
Training Days	14	10	16	7
Functionality	90	80	75	65

##### Normalized Cost/Training/Functionality Data

Tool	OKTA	AUTH0	Azure Active Directory	Firebase Authentication
Cost	100	35	0	0
Training Days	87.5	62.5	100	43.75
Functionality	100	88.8	83.3	72.2

##### Normalized Tool Graph



**Tool for Deep Learning:**

We decided to use TensorFlow due to its comprehensive suite of tools tailored for deep learning tasks. The platform's APIs, libraries, and tools provide significant ease of use for developers, facilitating the handling of even the most complex projects. TensorFlow's robust support and extensive documentation further enhance its accessibility, making it an ideal choice for our deep learning requirements.

### SOFTWARE TOOLS FOR TASK 3:

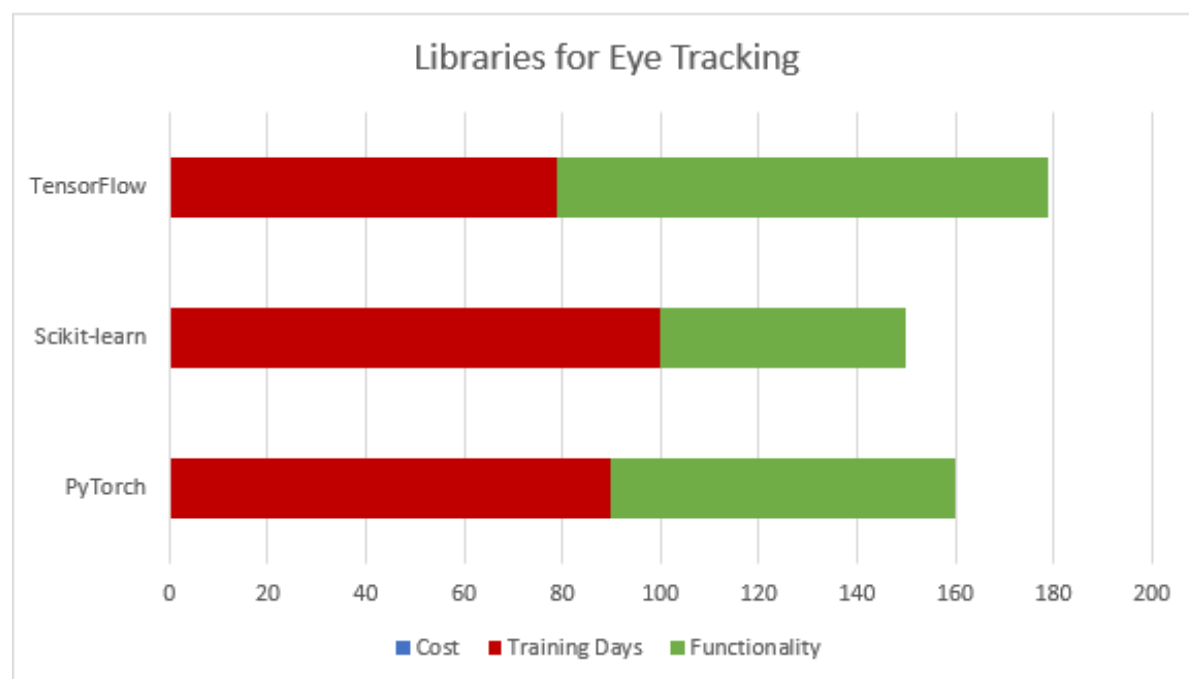
#### Tool Cost/Training/Functionality Data

Tool	PyTorch	PyTorch	PyTorch
Cost	0\$	0\$	0\$
Training Days	21	24	18
Functionality	94	82	78

#### Normalized Cost/Training/Functionality Data

Tool	PyTorch	PyTorch	PyTorch
Cost	0	0	0
Training Days	87.5	100	75
Functionality	100	87.2	82.9

#### Normalized Tool Graph



## STAKEHOLDERS

This project involves three main types of stakeholders:

- Development Team
- Customers
- Other Staff

### Development Team

The Development Team is primarily in charge of the project's technical components. This team includes software developers, testers, data scientists, and project managers.

The Development Team's primary responsibilities are:

- Software development is the process of designing, creating, and implementing software to meet the project's needs.
- Monitoring entails identifying and fixing issues that happen during the development and testing stages.
- Continuous improvement entails regularly analyzing and upgrading development processes, as well as integrating new tools and approaches.

The Development Team is important to guaranteeing the project's success. Their skill and dedication ensure that the project is completed on schedule and within budget.

### Customer

Customers are the project's end users, and their demands and expectations may vary.

Customers can generally be categorized into the following categories:

- Those with Lazy Eye or Seeking Improvement with Eye Exercises:  
This category covers persons who suffer from eye problems such as amblyopia and want to improve or relieve their symptoms through eye exercises. These clients can focus on better eye exercises and reading speed.
- School Students:  
The software can help students improve their reading speed while also protecting their eyes. They may require characteristics that alleviate eye fatigue, particularly for homework and studies that involve prolonged reading.
- Older People:

The software can help elderly people protect their eyesight and maintain their reading abilities. This category may look for traits that are crucial for preserving good eye health and preventing age-related eye illnesses.

- **General Users:**

Other users may download and use the software for pleasure or to safeguard their eyes. These people frequently utilize software for general goals, such as improving reading enjoyment or minimizing eye strain.

Each client group represents a distinct sector with unique requirements and expectations.

### **Supporting Staff**

Supporting Personnel play a vital role in the success of the project and can be broadly split into two groups:

- **Text Providers or Writers:**

This category includes individuals who generate or offer the texts that the program will use. They must give appropriate texts for measuring. To test reading speed, these texts should be of different complexity and length. Text suppliers must give balanced and diversified content in order to effectively assess users' reading abilities and speeds.

- **Doctors or Eyecare Professionals:**

This group is critical to advancing the project's eye health goals. They provide information and advice on effective activities and tactics for maintaining and improving eye health. They can also provide specific advice for improving or maintaining eye health. This could improve the project's overall success by providing users with health-related information and recommendations.

Both groups contribute to the project's success by producing solutions that match user demands and expectations. The development team shapes and develops the project while taking into account the contributions of the supporting staff.

## MEASUREMENTS

Questions to identify measurements and their identified measurements :

1. How much effort was required to implement and conduct the eye exercise program

1. Effort required to develop and implement the eye exercise program

Description: Measures the resources and time required to develop and implement the eye exercise program.

Why We Need It: To determine how much money and time we spend creating and implementing an eye exercise program.

2. How much time was spent on testing the effectiveness of the eye exercises?

2. Time spent on testing the effectiveness of the eye exercises

Description: Quantifies the duration of testing phases to evaluate the exercises' effectiveness.

Why We Need It: To determine how much time we spend in the testing stages to assess the effectiveness of eye exercises.

3. Did the project adhere to its schedule?

3. Scheduled program and time spent to sprints and deviations made

Description: Details the planned vs. actual time spent on development sprints and notes any deviations.

Why We Need It: To assess compliance of development processes with the targeted timetable and detect any deviations or delays.

4. How has the product evolved over time during the eye exercise program?

4. Product growth over time, measured by additions or modifications to features, exercises, or materials.

Description: Tracks product evolution through feature, exercise, or material additions or modifications over time.

Why Do We Need It? To monitor the evolution of the eye training program over time and assess the impact of new features, exercises, or materials.

5. How frequently were changes made to the modules/components of the eye exercise program?

5. Number of changes made to modules/components of the eye exercise program.

Description: Counts modifications made to modules or components of the program.

Why Do We Need It? To keep track of the frequency with which modules or components of the program are changed, as well as to assess the program's flexibility during development.

6. How many errors were found during and after the review?

6.1 Number of errors found in each reviewed product during the review

Description: Amount of errors identified in each reviewed product before quality review.

6.2 Number of errors found in each reviewed product after the review

Description: Amount of errors found in each reviewed product after quality review.

Why We Need It: To establish the product's quality by evaluating the number of flaws discovered during quality inspections.

7. Regarding the implementation of YOLO, how does one evaluate the overall quality of the program, considering metrics such as object recognition accuracy and speed?

7.1 (Precision-Recall Curve) A curve showing the F1 score at different precision thresholds and sensitivity values can be drawn.

Description: A graphical representation showing the F1 score across different precision thresholds and sensitivity values.

Why We Need It: It allows us to visualize the model's performance at different degrees of precision and sensitivity.

7.2 (Cross-Validation) F1 scores can be calculated on different data partitions to evaluate the generalization ability of the model.

Description: F1 scores from different data partitions to assess the model's generalization ability.

Why We Need It: It is used to evaluate the model's generalization capacity by testing it on diverse sets of data.

7.3 F1 scores can be recorded at regular intervals to monitor how the model's performance changes over time.

Description: Regularly recorded F1 scores to monitor changes in the model's performance.

Why We Need It Used to track the model's performance over time and detect changes.

## **NEEDS**

### **Software Needs**

**Integrated Development Environment (IDE):** IDE is environment where you develop your app. We have chosen PyCharm since we will use Python as our programming language.

**Programming Language:** Given our target platform, we have selected Python as our programming language.

**Interactive Text:** We will implement algorithms to process text efficiently for speed reading. This might involve techniques like breaking text into smaller chunks, adjusting display speed, or highlighting text dynamically.

**User Interface (UI) and User Experience (UX) Design:** Design an intuitive interface optimized for speed reading and eye-tracking interaction. Factors like readability, text size, contrast, and navigation will be considered.

**Testing Tools:** Testing tools are to ensure that the app functions properly across different devices and scenarios. This includes both functional testing (ensuring features work as intended) and usability testing (evaluating user experience).

**Analytics and Data Tracking:** Analytics will be integrated to track user behavior and performance metrics. This data can help you understand how users interact with the app and identify areas for improvement.

### **Hardware Needs**

**Camera:** Camera device to capture and analyze eye movement data.

**Device Compatibility:** Compatible with wide range of devices, including smartphones, tablets, and computers. Factors like screen size, resolution, and processing power should be considered.

**Server Infrastructure:** A powerful server is required to process large datasets and accelerate training processes.

**Wi-Fi Connection:** Fast and reliable Wi-Fi connection for data transfer and updates.

### **Support Needs**

**Tutorials:** Tutorials must be provided to help developers that are inexperienced about eye tracking tools.

**Updates and Maintenance:** Program must be regularly updated to fix bugs, improve performance, and add new features.

**Training and Onboarding:** Our program will offer training materials and resources for users who are new to speed reading techniques or eye-tracking technology.

**Legal and Privacy Compliance:** We need to ensure compliance with legal and privacy regulations governing the collection and use of eye-tracking data.

## RISKS

Project risks will be identified and analyzed using a comprehensive risk assessment process to guarantee that any potential dangers are addressed in a proactive manner.

LIKELIHOOD RANK	IMPACT RANK	COMBINED RANK	RISK DESCRIPTION
1	1	2	<b>Yolo:</b> The camera may not perceive the motion due to some defect of the device
2	5	7	<b>Design Complexity:</b> The varying nature of exercise modules, user preferences, language options, and personalized progress tracking introduces a significant design complexity risk.
6	2	8	<b>User data security and privacy:</b> Creating user accounts and storing sensitive data, such as personal health information, heighten security risks, especially focused on user authentication and profile management.
3	7	10	<b>Requirements volatility:</b> The project's requirements may change over time as new user needs are identified which could affect the scope and design of the platform.
4	6	10	<b>Testing:</b> Due to the adaptive nature of exercises and the need for personalized recommendations, testing all possible scenarios may be complex.
8	4	12	<b>System performance and scalability:</b> The platform must handle heavy user load and a growing number of exercises, that makes performance a significant risk.



11	3	14	<b>Compliance with regulations:</b> As the platform handles personal data and potentially operates in multiple regions, compliance is a significant risk.
5	10	15	<b>Debugging:</b> Advanced functionalities like eye tracking and performance metrics increase the complexity of identifying and fixing defects.
7	8	15	<b>User accessibility and inclusivity:</b> Ensuring the platform is accessible to all users, including those with disabilities. This is a risk that may cause legal and ethical implications.
10	9	19	<b>Multi-language support:</b> Offering content and UI in multiple languages increases the complexity of development and maintenance.
9	11	20	<b>User interface:</b> The platform must be intuitive for users of all ages and skill levels, which can be challenging given the range of functionalities.

## PAYOFF

### Project Goals and Objectives.

**Achieved:** Get access to all platform features. You may edit your skills, profile details, goals, and other settings.

**Comprehensive User Experience:** The platform allows users to select exercises based on their age group and specific goals, thus offering a personalized learning experience.

### Economic and Time Savings

**Cost Savings:** The digital platform allows for considerable savings on training and therapy expenditures.

**Time Saving:** Users may perform daily eye workouts quickly, allowing them to devote more time to other daily tasks.

### Technical Achievements and Innovations

The platform has maximized users' development by using innovative technologies such as variable difficulty levels and eye tracking.

**Various Eye Exercises:** Dot tracking, zigzag, and square visual field exercises were used to improve reading speed and reduce amblyopia difficulties.

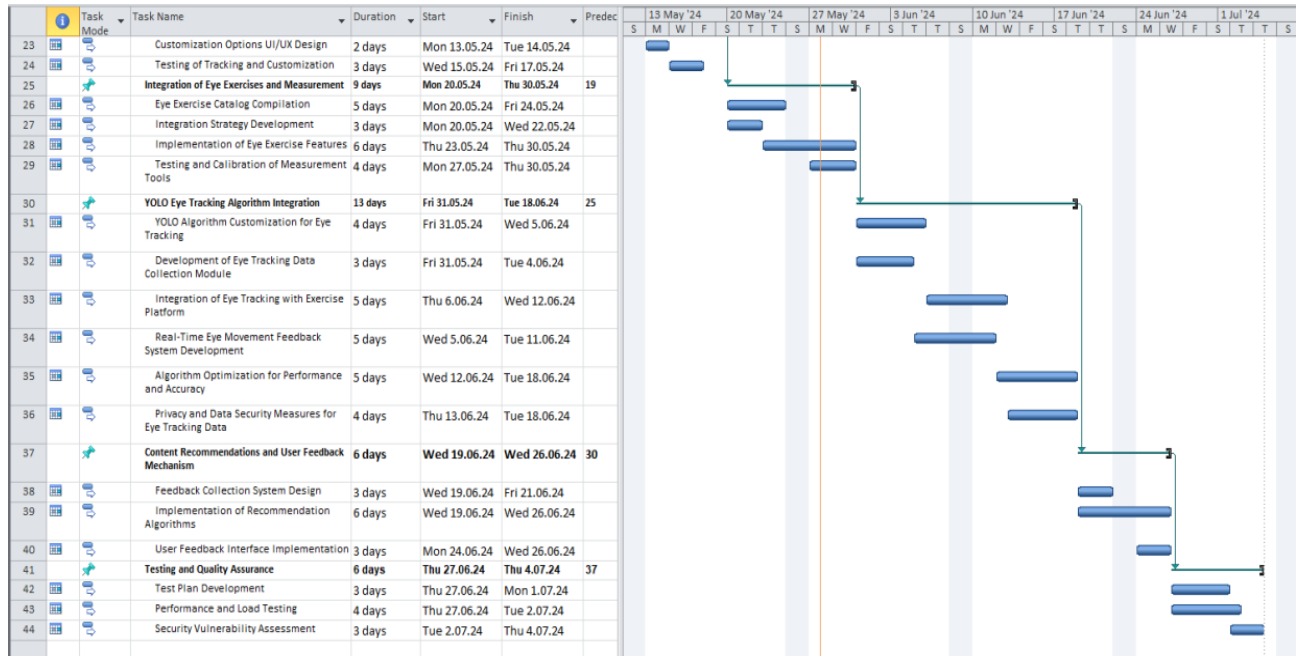
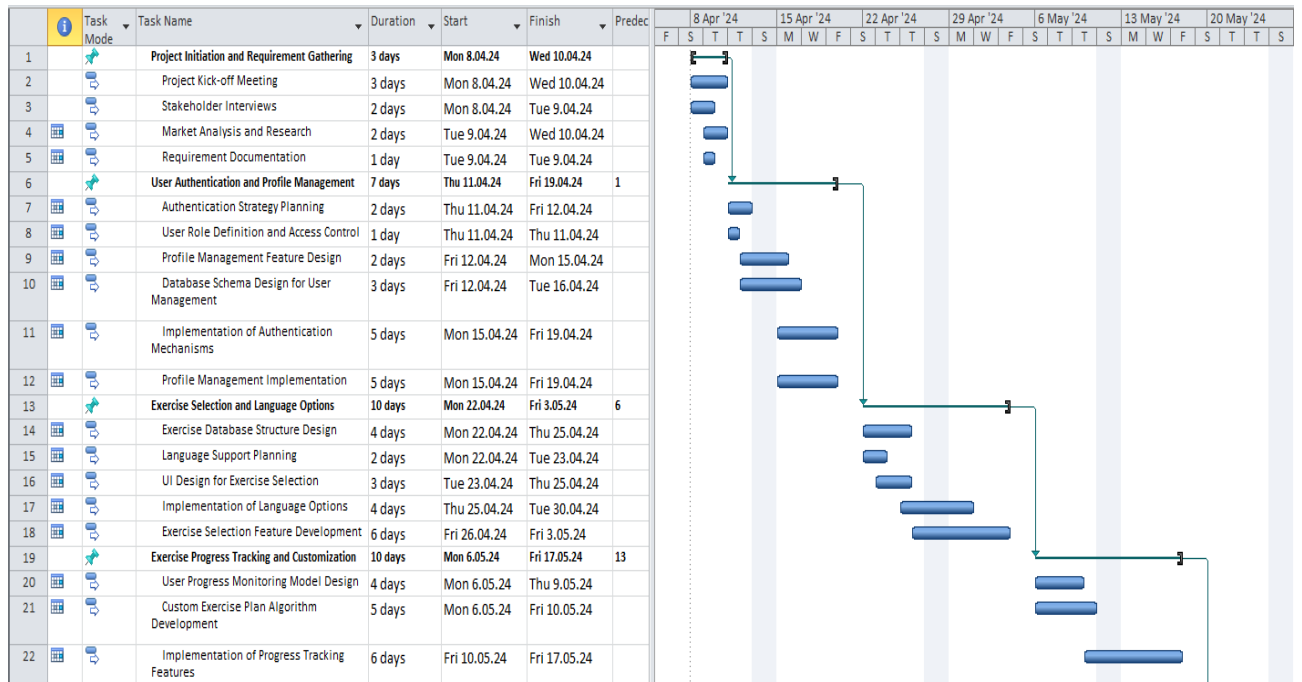
### Future of the Project and Sustainability

**Continuous Improvement:** The platform will be updated and enhanced in response to user comments and analysis.

**Extensibility:** The platform is intended to be expanded with more modules and exercises in the future.

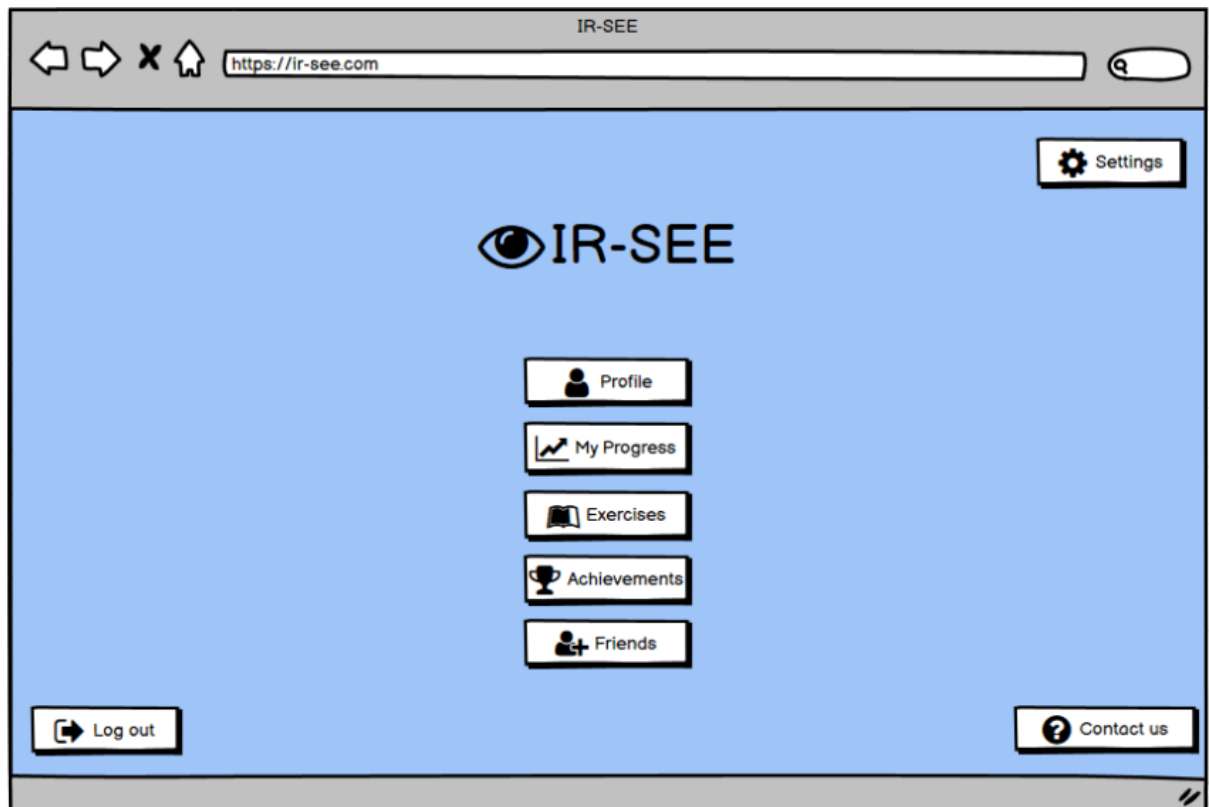
## GANTT-CHART

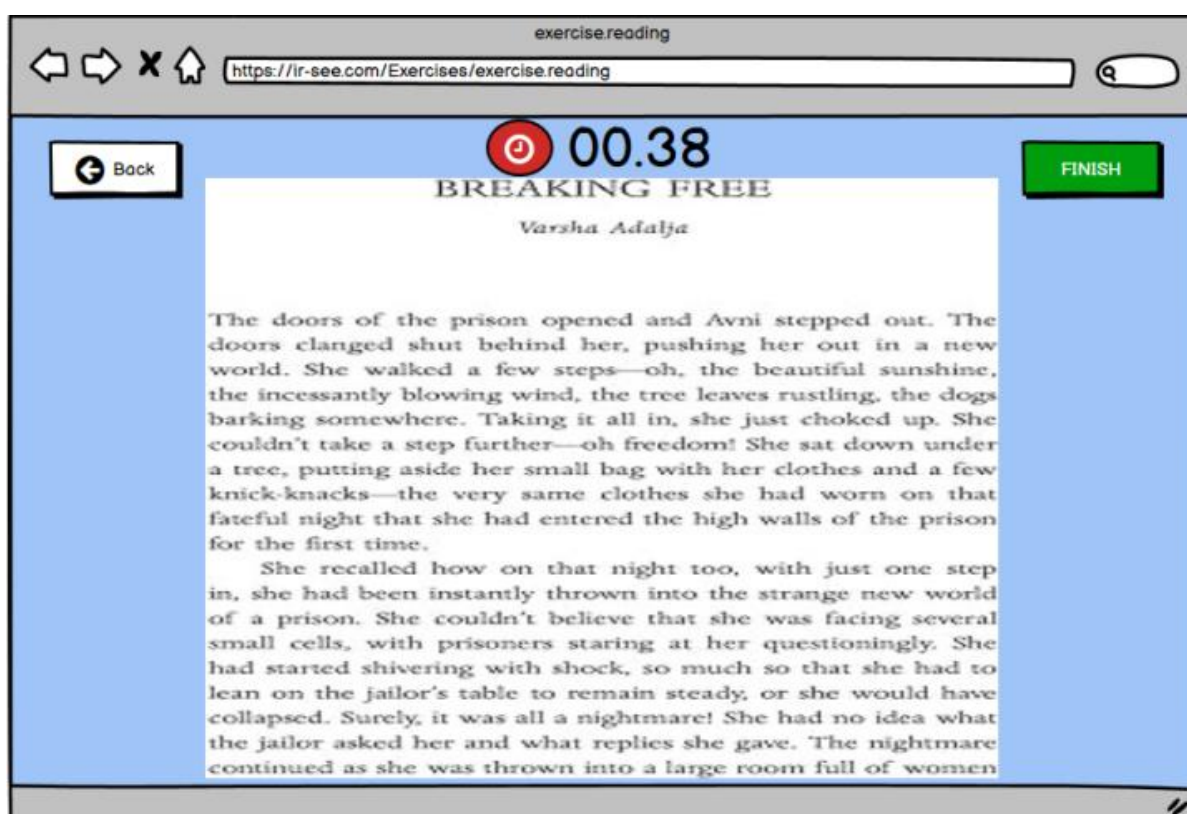
### Project schedule for IR-SEE



## USER INTERFACES

Some screenshots from IR-SEE web page







## CONCLUSION

The IR-SEE (Improving Reading Speed with Eye workouts) initiative was successful in creating a platform that improves reading speed, comprehension, and eye health through interactive and tailored workouts for people of all ages. The software successfully records user progress and provides advanced features like user authentication, workout monitoring, and linguistic assistance.

The platform's robust technological basis was built on Firebase for database administration and authentication, as well as TensorFlow for deep learning. Stakeholder input, including inputs from text providers and eyecare experts, was critical in fine-tuning the exercises and guaranteeing the platform's success. Risk management was central to the project, with early detection and mitigation measures guaranteeing little interruption. Regular measures of effort, testing time, schedule adherence, product evolution, and mistake rates all contributed to the project's quality and performance.

To summarize, IR-SEE has developed a dynamic and effective platform that meets the different demands of its users. It is well-positioned to considerably increase reading abilities and eye health in a variety of groups.

**FUTURE WORKS**

We plan to develop iOS and Android applications to make the platform more accessible on mobile devices. Adding more language options will help cater to a diverse user base. Integrating the platform into educational curriculums will enhance students' reading skills. Additionally, developing our eye tracking camera will improve accuracy and reliability.