

# TeXel

## IT 497: Graduation Project Report Product Release-2

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# Texel

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**Abstract (English):** Texel stands at the forefront of critical challenge in the rapidly evolving world of technology, where individuals face vital problem that threatens to undermine efficiency and innovation. As they search for solutions amidst a flood of scattered information, they waste time and feel frustrated. The purpose of developing the Texel software system is to address this problem and enhance productivity and collaboration in the technology community. Texel utilizes Agile methodology, specifically the Scrum framework, as its main approach towards development. This allows the system to continuously evolve based on the ever-changing user requirements. Evaluation of Texel has shown a positive impact on users. The design effectively addresses the core problem, and the development efforts have resulted in a highly usable and efficient application. Texel's simple yet powerful interface elevates the user experience, while its intelligent content recommendation system transforms the exhausting search process into seamless and fruitful experience. In conclusion, Texel is not merely an application, but a game-changing solution that serves as an essential ally for anyone striving for excellence in the world of technology. By saving time and effort and enhancing communication and collaboration in the tech community, Texel represents a profound transformation in how individuals navigate the complex digital realm.

**Abstract (Arabic):** Texel يقف في طليعة تحديات الحرجة في عالم التكنولوجيا المتشارع بالتطور، حيث يواجه الأفراد مشكلة تهدد بانهيار Texel الإنتاجية والابتكار. في بينما يبحثون عن حلول في وسط كم هائل من المعلومات المبعثرة، يضيع الوقت ويشعرن بالإحباط. الغرض من تطوير Texel وتحديداً إطار عمل، Agile منهجه Texel هو معالجة هذه المشكلة وتعزيز الإنتاجية والتعاون مع مجتمع التكنولوجيا. يستخدم نظام Scrum كنهج رئيسي للتطوير. وهذا يسمح للنظام بالتطور المستمر بناءً على متطلبات المستخدم المتغيرة باستمرار. وقد أظهر تقييم تأثيراً إيجابياً Texel كنهج رئيسي للتطوير. وهذا يسمح للنظام بالتطور المستمر بناءً على متطلبات المستخدم المتغيرة باستمرار. وقد أظهر تقييم إلى تطبيق فعال وقابل للاستخدام بشكل كبير وبفاءة Texel على المستخدمين. حيث يعالج التصميم المشكلة الأساسية بفعالية، أدت جهود تطوير البساطة والفعالة على الارتفاع بتجربة المستخدم حيث يحول نظام التوصية الذكي بالمحظى عملية البحث المرهقة إلى Texel عالية. تعمل واجهات ليس مجرد تطبيق، بل هو حل يغير قواعد اللعبة ويعلم كحليف أساسى لأى شخص يسعى Texel تجربة سلسة ومترفة. وفي الختام، فإن تطبيق تحولاً عميقاً في كيفية Texel للتميز في عالم التكنولوجيا. من خلال توفير الوقت والجهد وتعزيز التواصل والتعاون في مجتمع التكنولوجيا، يمثل تحولاً عميقاً في كيفية Texel للتميز في عالم التكنولوجيا. من خلال توفير الوقت والجهد وتعزيز التواصل والتعاون في مجتمع التكنولوجيا، يمثل

**Keywords:** Skills: the actual abilities possessed by the user.

Interests: topics that draw a user's attention

Upvote: the action taken when a certain answer is helpful.

Score: the total number of upvotes

## 1 Introduction

The technology industry is a dynamic and rapidly evolving sector critical in driving innovation, digital transformation, and connectivity across multiple sectors. It encompasses various areas such as software development, information and communication technology, digital services, and application services. Keeping pace with updates in this industry can make processes faster and less complex. Within the technology industry, our project focuses explicitly on addressing the challenges faced by individuals seeking superficial and deep technical assistance, information, and self-development.

A common problem technology professionals face is wasted time and frustration searching for answers or solutions to technical issues, inquiries, or information about relevant events and programs. Additionally, individuals often seek ways of technical self-development and self-learning. The continuous search for information can have a negative impact on productivity, hinder progress, and discourage individuals. This problem is further compounded by the sparse and incomplete information available across various platforms. Individuals often navigate multiple platforms to access the desired information or resources, whether seeking answers to technical inquiries or acquiring knowledge for self-development, where each technical aspect is on a different platform, and no platform collects all the needed information in one place. Therefore, we came up with the idea of our application, where our proposed technological solution will help address challenges in the technology field we discussed before.

Given the widespread use of technology in our lives, it benefits both technical specialists and everyday users. Furthermore, our solution holds substantial importance for the local community and on a global scale; individuals can streamline workflows, access advanced features, and contribute to local and global technological advancements.

### **The Problem:**

Texel aims to address the prevalent issue of wasted time and frustration faced by individuals seeking technical assistance or information within the technology field. We understand that navigating the vast landscape of technology can be overwhelming and time-consuming, leading to frustration and inefficiency. A survey conducted by Stack Overflow, which involved 73,000 developers from 180 countries, revealed that approximately 63% of respondents spend more than 30 minutes daily searching for answers or solutions to problems, with 25% spending over

an hour each day [1]. This constant search for information and solutions can significantly impact productivity. For instance, in a team of 50 developers, the cumulative time spent searching for answers or solutions can amount to 333-651 hours lost per week, which is considered a considerable loss in time and effort.

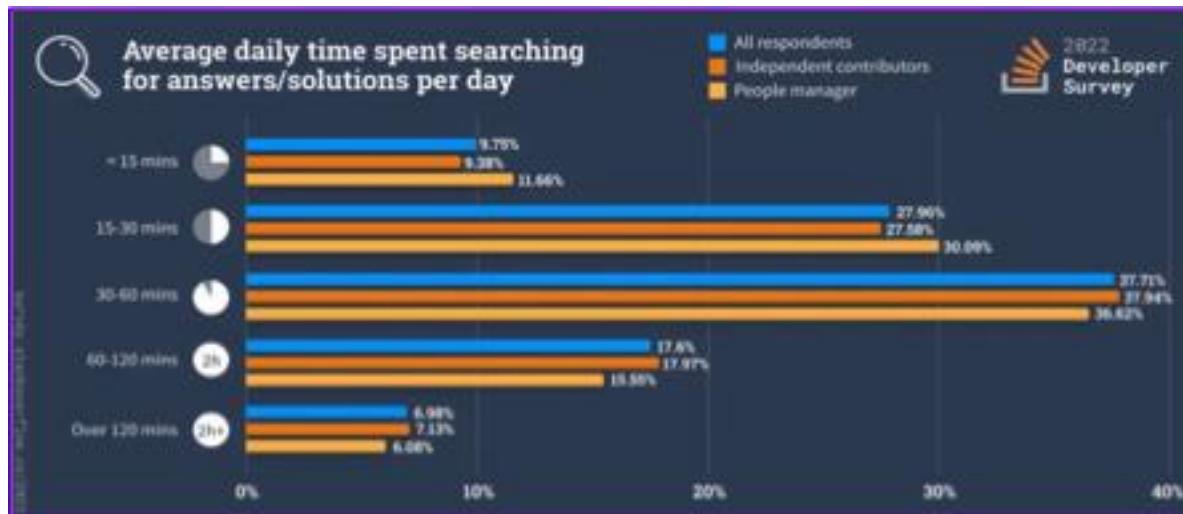


Figure 1: Average Daily Time Spent Searching for Answers/Solutions per Day. [1]

To illustrate this problem, let's consider Sarah, a technology enthusiast working on a programming project. Sarah encounters a complex issue and spends hours scouring various online platforms, including forums, documentation websites, and tutorial videos, searching for a solution. However, the information she finds could be more varied, often conflicting, and incomplete. This fragmented experience leads to frustration as valuable time is wasted, hindering Sarah's progress, and dampening her enthusiasm for the project.

The scenario we described with Sarah is indeed a common challenge in the age of speed, and it can also occur at the level of companies and businesses. The problem of fragmented information and time-consuming searches can significantly impact the progress and growth of companies and organizations. With a vast amount of information available from different sources, it becomes scattered and conflicting, resulting in wasted time, reduced efficiency, and missed opportunities for innovation.

## The Solution:

In response to the identified problem, we introduce Texel. Texel is an all-in-one innovative mobile application that revolutionizes how individuals in the technology field access solutions and opportunities. We understand the prevalent inefficiencies and frustrations encountered by individuals seeking technical assistance or information within the technology field. Our solution "Texel," is designed to alleviate these issues and provide a more efficient and productive experience, unlike traditional search methods that often lead to wasted time and frustration.

Texel addresses these inefficiencies by providing a streamlined platform for accessing technical solutions and opportunities. It caters to a diverse range of users within the technology domain, including technology enthusiasts, professionals, individuals with technical inquiries, and those seeking self-improvement.

Texel's feature-rich interface and recommender systems ensure a seamless user experience. Powered by AI, “Texel” delivers tailored recommendations for questions, courses, and events that align with each user's unique preferences, skills, and areas of interest.

By fostering collaborative discussions and interactions on the platform, Texel becomes a vibrant hub of knowledge sharing, enriching the experience for every user. Moreover, Texel serves as a gateway to various opportunities within the technology realm by connecting users with freelancers and providing collaboration requests, including paid projects, forming teams, and educational programs. Texel empowers users to stay informed and ahead of the curve through personalized recommendations of courses and events, facilitating continuous learning and professional development. With features like calendar integration and private messaging, Texel streamlines communication and organization, fostering effective collaboration and mentorship within the community. In essence, Texel embodies a vision of empowerment and collaboration, paving the way for a brighter and more connected future in the world of technology. As mentioned before, Texel's innovative approach directly tackles the prevalent challenges, providing users with a list of features to generate a solution that enhances productivity and facilitates seamless access to technical solutions and opportunities.

- **Texel product main features will include:**

1. **Engage & Connect:**

Texel facilitates community-wide public discussions by allowing users to post questions publicly and receive responses from other users. This feature encourages knowledge sharing and collaboration within the community. Additionally, the application provides an in-app search that allows users to easily search for solutions to their queries. This aims to streamline the process of finding relevant information, enabling users to quickly access the answers they need.

## **2. Post Request:**

- A. Submit fee-based requests, such as paid project opportunities (where payment arrangements are negotiated between the involved requester user and the freelancer user using private messaging).
- Freelancers are users who identify themselves as experts in specific fields during registration or when updating their account settings. They have the opportunity to showcase their specialized skills and knowledge, making it easier for other users to find and connect with them.
- B. Post requests to find opportunities for collaboration including facilitating communication for finding individuals for team formation for hackathons, competitions.

## **3. Display Technology Events and Courses:**

Keep users informed about the newest courses and popular events in the technology field. It's important to note that Texel does not organize these events directly. By incorporating this feature, Texel becomes a centralized hub where users can stay up to date with educational opportunities and technology-related events, conveniently exploring and engaging with the programs that align with their interests and professional growth.

## **4. Users' Personal Calendar for Technology Events and Training:**

Add technology events, conferences, programs, and training courses (mentioned in feature 3) to users' calendar in their profile.

## **5. Focused Learning Pathways:**

Offering fixed and curated learning pathways tailored to some specific topic, either programming languages, programming techniques, and frameworks, etc. These pathways provide users with a structured sequence of courses, such as: YouTube channels, and other relevant resources, facilitating their learning journey from A to Z. Texel's admins pick these

resources from different popular places to ensure users' learning journey from start to finish is well-rounded and easy to follow. These pathways are designed to provide a comprehensive and systematic approach to learning.

## **6. Private Messaging:**

Enable users to communicate with each other privately to exchange knowledge.

## **7. View Profiles:**

Explore a world of user profiles on our platform, where you can browse through the profiles of all users, including freelancers who have also their dedicated page. Our platform offers a simple and engaging way to discover and connect with a wide range of users and freelancers.

## **8. Personalized Recommendations for Questions:**

Our application utilizes artificial intelligence (AI) to provide personalized recommendations through a content-based recommender system. The recommendations are based on each user's interests, taking into account additional factors such as the user's skills, the date the question was added, the number of replies the question has received, and the total number of upvote the replies received. The importance of each factor is weighted accordingly. These personalized question recommendations are displayed in the main feed, ensuring that users receive highly relevant and valuable information. This approach enhances the overall user experience and fosters effective communication within the community.

## **9. Personalized Recommendations for Technology Events and Courses (Referring to feature 3):**

Our application utilizes artificial intelligence (AI) to deliver personalized recommendations for events and courses through a hybrid recommender system. By considering factors such as user location, preference for online or in-person events and courses and tracking similar users' in skills and interest interactions including recommending what one user liked to another, we tailor the recommendations to each user. We assign specific weights to these factors based on their importance. Our goal is to facilitate professional growth and engagement by providing users with meaningful opportunities for learning and networking.

## **10. Bookmarking:**

Allow users to bookmark specific discussions, events, courses, or learning pathways to enables users to easily access and revisit their preferred content without having to search for it again.

By leveraging these features, users can experience a wide range of benefits as we mentioned earlier, resulting in a significant local impact of improved productivity and expanded professional opportunities within technology communities.

### **Texel's Scope:**

Texel is a mobile application designed specifically for Android mobile application users, providing a seamless technology experience. The application is developed using the Flutter framework, with the code written in Dart programming language, and the development process is facilitated using the VS Code integrated development environment. Texel incorporates a recommender system component developed in Python, leveraging its capabilities in data processing and recommendation algorithms. Texel utilizes Firebase as its database technology, ensuring efficient data storage and retrieval. While Texel offers a range of features and functionalities mentioned above, it's important to note that optimal use of the application requires internet connectivity. Currently, Texel exclusively supports the English language. It's worth mentioning that the application does not include payment-related features or the registration of courses and events. The creation of teams within Texel is also out of scope; however, users have the opportunity to find their team members through the application. To make the most of Texel, users are expected to have basic knowledge and familiarity with mobile applications.

## Product Vision:

### Product Vision:

For people with technical questions, professionals seeking growth, and those willing to help others.

Who needs support and problem-solving, collaboration and networking opportunities, career development and growth, task engagement and freelancing opportunities.

The Texel is a Mobile Application.

That provides a platform that connects individuals in the technology community, fostering collaboration, learning, and growth. With the added advantage of a robust recommendation system, Texel enhances users' experience by providing personalized content and connections tailored to their specific interests and needs.

Unlike Upwork, GitHub and Stack overflow,

Our application combines features from various technology applications with additional unique ones in one place and utilizes AI technology for personalized recommendations, setting it apart from others.

## The Main Contribution:

The main contribution of the Texel project lies in its ability to consolidate features from various technology applications into a single platform while incorporating unique functionalities we mentioned before. By integrating these diverse features, Texel offers users a centralized hub for all their technology-related needs. Moreover, the application leverages AI technology to provide personalized recommendations using two different types such as Hybrid approached for coerces and event and content based for questions, setting it apart from similar platforms. This personalized approach enhances the user experience by offering tailored content and opportunities that align with individual interests and goals. By combining a wide range of features and utilizing AI technology, Texel strives to optimize user engagement, knowledge acquisition, and collaboration within the technology community.

Texel, a platform developed in Saudi Arabia, significantly impacts local and global. At a global level, Texel enables users worldwide to ask and answer technical questions, fostering an international community of knowledge sharing and collaboration. It also facilitates connections with freelancers, allowing for remote work opportunities and global expertise to be leveraged. Moreover, Texel provides access to pathways, allowing users from various locations to explore learning paths tailored to their interests. On a local scale, Texel

empowers users within the Saudi Arabian community to build teams, fostering local collaborations and networking opportunities. It serves as a platform for local businesses and individuals to find freelancers for their projects, promoting local and global talent and supporting the growth of the local economy. Additionally, Texel shares local courses and events, providing valuable resources for individuals seeking to enhance their skills and stay updated with local tech advancements and opportunities.

In summary, Texel's impact spans both local and global spheres. It facilitates international knowledge exchange, collaboration with freelancers, and access to pathways while supporting local team building, talent development, and engagement with local courses and events. This dual impact positions Texel as a valuable platform for the global tech community while maintaining a strong foundation within the local Saudi Arabian ecosystem.

## Methods:

Texel's approach involved several meticulously planned stages to ensure a robust, user-centered solution. Initially, we conducted comprehensive user research to understand the needs and preferences of our target audience through some surveys. This insight guided the subsequent design phase, where we crafted a detailed system architecture and refined the user interface to enhance usability.

During the implementation phase, we developed the system iteratively following agile methodology, with regular assessments to monitor progress and ensure alignment with project goals and roadmap. Following implementation, we rigorously tested the features to verify that all requirements and criteria were met.

A vital component of the project was the development of a recommender system. We began by collecting data from Texel users, followed by a thorough data cleaning and pre-processing process to ensure the data's quality. This data was sent directly to the recommender algorithm in real time, enabling immediate and relevant suggestions without model training. We asked Texel users if the suggested content was relevant to gauge how well the recommender system worked. Under each recommendation, users could say whether it matched their interests or needs. This direct feedback loop helped us fine-tune the system to give better suggestions and keep users engaged.

The report is structured to provide a comprehensive overview of the project's development process. It begins with an introduction that outlines the problem inspiring our undertaking of this project, the proposed solution, the product vision, and the scope of the product, establishing the boundaries of the problem we aim to address. Following this, the background section discusses recommendation systems and necessary external software, such as APIs. Further, the literature review delves into our field of study, including a competitive product analysis. System requirements are detailed next, covering aspects such as system users, elicitation, analysis, and user interaction in the use case diagram, followed by the roadmap and product package. System design follows, discussing architecture, class diagram, and component-level design. Data models like ER and non-relational data models were provided in the data design section. Then, interface design is discussed. System implementation is then explored, detailing the steps taken to bring the design to life. The evaluation phase includes user acceptance testing, demographic analysis, questionnaire/interview results, and discussion. The document concludes with a summary of findings and accomplishments and a forward-looking perspective on potential future enhancements and developments for Texel. Finally, the report concludes with reflections on the project, future work, acknowledgments, and references.

## 2 Background

### Recommendation System:

Texel will include a recommendation system to enhance the user experience. But what exactly is a recommendation system? This document chapter will discuss what a recommender system is, its benefits, and the various types and subcategories. Finally, the use of the recommender system in Texel has been summarized.

A recommender system, as defined in the Encyclopedia of Machine Learning, is a system where products or services are suggested to users based on their interests or interactions [2]. These recommendations are generated by AI algorithms utilizing machine learning techniques. The design of recommender systems is based on the specific domain and the factors derived from the available data [3]. For instance, eBay incorporates a feedback feature that allows customers (both buyers and sellers) to leave ratings (positive, negative, or neutral) along with short comments about their business interactions. This feedback contributes to building profiles for buyers and sellers and is used in eBay's recommender system to provide recommendations of sellers to buyers [4].

The primary goal of using a recommendation system is to increase profits by engaging users to stay longer in the app and suggesting relevant products [5]. Recommender system has three

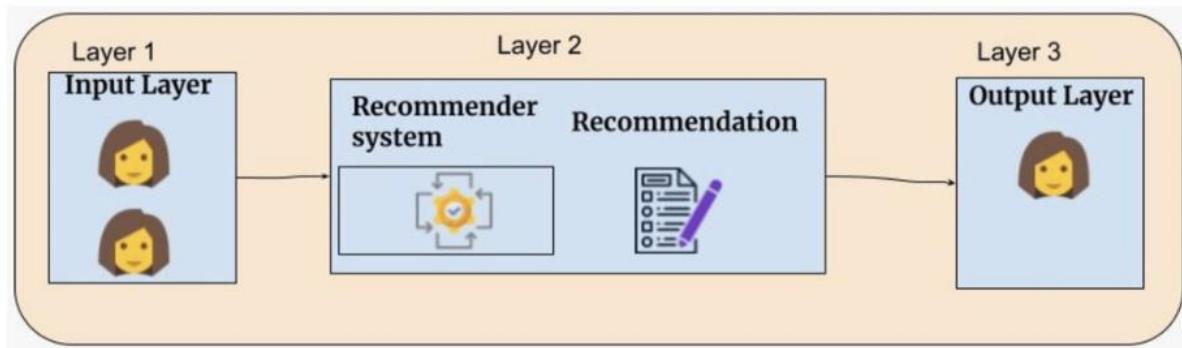


Figure 2: Recommender System Process [12]

main types: collaborative filtering, content-based methods, and hybrid recommender systems. collaborative filtering recommends products or services to similar users based on their behavior. In contrast, content-based methods recommend items based on user characteristics. Hybrid recommender systems merge collaborative filtering and content-based methods, addressing the limitations of each approach [6].

- **Recommender Systems Advantages:**

A recommender system offers several benefits for both users and companies, which can be summarized in the following three points:

**1- Increased Company Profitability:** Companies can increase their profitability by engaging users to spend more time on the platform and suggesting items or services that align with their preferences [5].

**2- Reduced Time and Effort for Users:** By providing users with quick and convenient access to relevant products or services in one place, rather than requiring them to search for them, recommender systems significantly decrease the time and effort wasted by users.

**3- Enhanced User Satisfaction:** As previously stated above, both factors will eventually lead to user satisfaction simply because the recommender system will assist in creating a unique experience for the user to meet his needs.

- **Recommender System Types:**

#### **A. Collaborative Filtering:**

Collaborative filtering includes two primary subcategories known as memory-based and model-based approaches. Memory-based approaches utilize nearest neighbor search and operate based on recorded interaction values, assuming no model exists. For example, identify the nearby users from a user of interest and recommend the most liked movie among these neighbors. Memory-based approaches are relatively simple to implement and computationally efficient. They can effectively handle large datasets and scale well with increasing user and item dimensions, making them practical for real-world recommendation systems. On the other hand, the model-based approach in collaborative filtering assumes the existence of a generative model that explains the user-item interaction. It seeks to discover this underlying model to make new predictions. Instead of relying solely on recorded interaction values, the model-based approach aims to understand the patterns and dynamics of user-item interactions through the generative model. This approach can provide more accurate and personalized recommendations by capturing complex relationships and dependencies within the data.[6]

- **Advantages:**

**1- Efficiency in Content Analysis:** Collaborative filtering algorithms do not require extensive content analysis [7]. This eliminates the need for time-consuming processes such as language analysis, document parsing, and word-stemming algorithms. Instead, collaborative filtering algorithms utilize clustering techniques to generate recommendations [7].

**2- User and Item Profiles:** Collaborative filtering algorithms create user and item profiles, eliminating the need to store massive amounts of word frequency data for each user and document [7]. By leveraging these profiles, collaborative filtering algorithms can identify items that a particular user might be interested in, even if the user has not explicitly rated or interacted with those items [8].

- **Disadvantages:**

**1- Cold Start Problem:** Collaborative filtering suffers from the cold start problem, where it becomes challenging to recommend items to new users or recommend new items to any user [6]. Collaborative filtering algorithms need more user-item interaction data to generate accurate recommendations.

**2- Scalability Issues:** The scalability of collaborative filtering algorithms can be a concern when dealing with many users and items [6]. The computational power required to calculate recommendations increases significantly as the dataset grows.

**3- Sparsity:** Collaborative filtering approaches can encounter the sparsity problem, mainly when dealing with top-rated items [6]. Sparse data occurs when there is a limited number of ratings or interactions for frequently recommended items. This can affect the accuracy and diversity of recommendations, as the algorithm may need more information to draw upon for those items.



Figure 3: Collaborative Filtering Process [13]

## B. Content-based:

Content-based recommendation systems offer a distinct approach by allowing a system to characterize each user uniquely without relying on matching their interests to other users [9]. In content-based methods, recommendations are based on item information rather than depending on other users' preferences. The primary objective of content-based techniques is to construct a model using the available "features" associated with the items [6]. Unlike collaborative filtering, content-based methods handle the cold start problem effectively since they have a basis for generating recommendations by using the provided item features. There are two main methods in content-based recommendation systems: classification and regression [6]. The recommendation problem is formulated as either a classification or a regression problem, where items and their ratings serve as training data to generate the classification or regression models. [3]

- **Advantages:**

**1- Recommendation of New Items:** One of the advantages of content-based methods are their ability to easily recommend new items that have yet to be rated [5]. Unlike collaborative approaches, content-based methods can define new users or items based on their characteristics (content), enabling appropriate recommendations for these entities [6]. This is particularly beneficial in addressing the cold start problem, as the system can leverage the item characteristics to generate recommendations.

**2- Transparency:** Content-based methods provide transparency by explaining to users how the recommender system works [10].

- **Disadvantages:**

**1- Overspecialization Problem:** Content-based filtering can suffer from the overspecialization problem, where recommendations tend to suggest the same items repetitively [10].

**2- Limited User Ratings:** Determining the correctness of recommendations in content-based filtering can be challenging due to the reliance on user ratings. If users have yet to rate a sufficient number of items, assessing the recommendations' accuracy and relevance becomes difficult [10].

**3- Content Analysis Challenges:** Content-based filtering requires the analysis of content using an appropriate model, and obtaining the analyzed and represented content can be challenging [7].

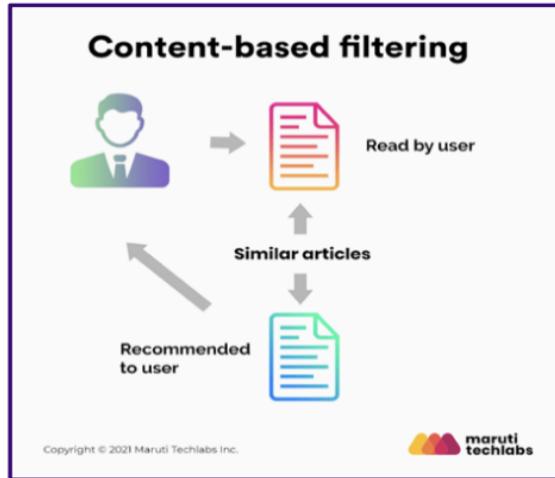


Figure 4: Content-based Filtering Process [13]

### C. Hybrid Method:

In a hybrid approach, the two recommended techniques, content-based and collaborative filtering, are merged to get the best advantage, gain better results, and reduce the issues and challenges of these applications. There are multiple methods to implement the hybrid approach mixing, where the system recommends multiple different items together at the same time to the user; weighted, when we combine numerically every recommended component given a different score by the system; and switching, where the system has multiple choices of different recommendation item to the user and chooses the preferable one according to the user preference. [11]

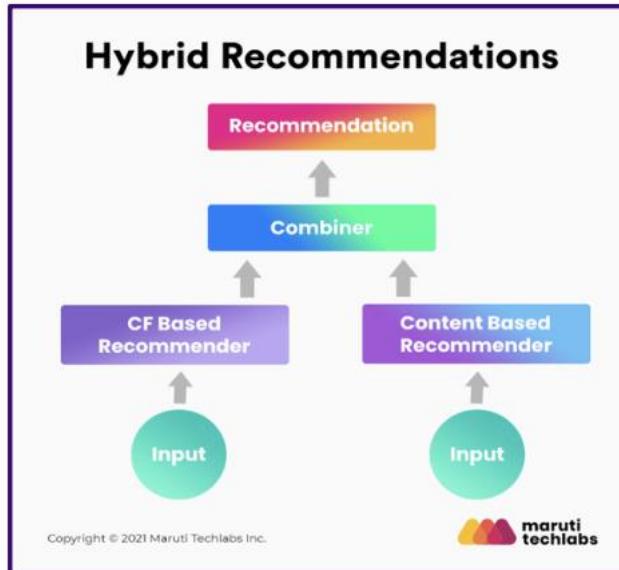


Figure 5: Hybrid Approach Process [13]

- **Recommender Systems Used in Texel:**

Texel platform will employ content-based and hybrid techniques based on the specific problem. The content-based technique will be utilized to recommend questions. It uses similarity measures to assess the likeness between user's interests and additional characteristics such as their skills and the date the question was added. These characteristics are not treated in isolation but are evaluated in relation to each other, and the resulting similarities are then weighted according to their respective importance. By leveraging similarity measures, Texel ensures that recommended questions align closely with the individual user's preferences, creating a highly personalized experience. The recommended

questions will be displayed in the main feed. As the main feed serves as the primary gateway, the content-based approach will effectively mitigate the cold start problem, allowing users to engage with relevant content seamlessly from the outset.

In the case of technology events and courses, a hybrid technique will be employed. In the hybrid approach, similarity measures continue to play a crucial role. The content-based part of the approach will consider user interests, location, and preferences for online or in-person events and courses as features. On the other hand, the collaborative filtering part will track the interactions of similar users. Simultaneously, the collaborative filtering part employs similarity measures to track the interactions of similar users, evaluating the likeness in their preferences and behaviors. Appropriate weights are assigned to these measures, ensuring optimal accuracy in the resulting recommendations. This hybrid methodology maximizes recommendation accuracy by leveraging the strengths of content-based and collaborative filtering techniques, providing users with a well-rounded and tailored experience.

Texel's recommender system relies on data sourced directly from Texel users. This includes user-provided information, such as interests and skills, which users register, offering insights into their preferences. Additionally, the system tracks user interactions within Texel, ensuring a comprehensive understanding of user behavior. This dual approach, incorporating user-provided data and user interactions within the platform, enhances the recommender system's ability to deliver accurate and personalized recommendations.

**APIs Used in TeXel:**

• **Firebase API:**

The Firebase API is a suite of APIs provided by Google that enables developers to access Firebase services, including the Realtime Database, Cloud Firestore, Authentication, and more. This API is useful for applications requiring real-time data synchronization, authentication, and storage, such as chat apps, gaming apps, or social media platforms. The API provides a range of features, including data storage, authentication, authorization, and analytics. This allowed us to build scalable, secure, and high-performance applications quickly. This API was used in TeXel to build its database, access it, and benefit from all Firebase features. [14] [15] [16] [17]

• **Algolia Search API:**

The Algolia Search API, a powerful extension in Firebase, provides robust search functionality for applications. It is ideal for applications that demand fast and relevant search results, such as content management systems and social media applications. By leveraging this API, we can significantly enhance the overall user experience, making it easier for users to discover the information they need. In TeXel, we utilized this API to implement various search functionalities, including searching for questions, courses, pathways, and more. [18]

• **CSC API:**

The Country-State-City API, a powerful Flutter API, provides a comprehensive list of countries, states, and cities. Ideal for applications requiring location-based input, this API enables users to select their location quickly. By returning a list of countries, states, and cities, the API can populate dropdown menus or autocomplete fields, facilitating seamless location selection. This, in turn, enables the provision of location-based services and personalized user experiences. In TeXel, we leveraged this API to simplify the process of users entering their locations. The implementation details of this integration are further elaborated in the implementation section of this document.[19]

- **Calendar API:**

The Syncfusion Calendar API, a robust Flutter API, empowers users to view and interact with calendar events seamlessly. This API offers comprehensive features, including creating, reading, updating, and deleting events, allowing for effortless calendar management. In TeXel, we leveraged this API to enable users to save their desired courses and events to their calendars, thereby helping them manage their schedule and schedules effectively. The implementation details of this integration are further elaborated in the implementation section of this document.

[20]

- **TeXel Recommendation Systems API(User-defined API):**

a Flask API defined by us specifically to recommendation systems in TeXel application. It provides two endpoints: recommendQ and /recommendCE.

The first endpoint (recommendQ) is used to recommend questions to a user based on their skills and interests. It takes in a JSON payload with three keys: user\_skills, user\_interests, and all\_questions. The recommended questions IDs are then returned as a JSON response.

The second endpoint (recommendCE) is used to recommend courses and events to a user based on their profile and preferences. It takes in a JSON payload with three keys: user\_Email, all\_users, and all\_CoursesEvents. The recommended courses and events IDs are then returned as a JSON response.

Here is a summary of the API endpoints:

Endpoint 1: /recommendQ

- Method: POST
- Input: user\_skills, user\_interests, and all\_questions
- Output: recommended question IDs

Endpoint 2: /recommendCE

- Method: POST
- Input: user\_Email, all\_users, and all\_CE
- Output: recommended course/event IDs

### 3 Literature Review

The literature review is a critical component of the Texel platform as it determines requirements and justifies the approaches considered. This review synthesizes similar or related work and positions Texel in comparison to other efforts.

Understanding the existing landscape is crucial, but what's more important is understanding the users and their challenges. The literature review, therefore, takes a user-centric approach, analyzing relevant literature to gain insights into user challenges and identify potential gaps and deficiencies in current solutions.

The review follows a comprehensive organizational pattern for systematic exploration; it summarizes important information from each competitor, recapping key insights and features. Synthesizing the literature establishes a solid foundation for Texel's development, explaining all aspects and solutions to address the identified problem. It also explores existing approaches and strategies in a thorough manner.

Additionally, we compare Texel to other efforts to identify features and potential areas for improvement. Our focus is on effectively and efficiently addressing the identified problem without the obligation to have more features than other reviewed projects.

Ultimately, the literature review provides robust support for the Texel platform, providing a foundation for selecting features, functionalities, and strategies. It ensures a well-informed and impactful solution to the problem we address.

#### **Competitive Product Analysis:**

Several notable players in the industry offer similar services to our platform. These competitors have established themselves as leaders in their respective domains, catering to the needs of various users.

##### **The Notable Competitors in The Industry Who Provide Similar Features:**

##### **upwork Upwork:**

Upwork is a freelancing platform that connects clients with freelancers across various fields, offering a marketplace for clients to post job opportunities and for freelancers to showcase their skills and experience.[21]

- Post Requests for Collaboration in Fee-Based Projects: On the Upwork platform, users are allowed to post requests for fee-based projects.

- **Freelancer Marketplace:** On the Upwork platform, users are allowed to post a project request, and they can determine the price for the project. Users can specify their budget when posting a job, and freelancers can submit their proposals accordingly. Upwork facilitates the management of the relationship between the freelancer and the user, including aspects such as payment handling, ensuring a smooth and secure transaction process.

-**Personalized Recommendations:** On the Upwork platform, it shows the user the freelancers who have skills and knowledge that match or meet the posted project requirements and description.

**Features not Provided on Upwork:** Post requests for facilitating communication for finding individuals for team formation, Facilitation of community-wide public discussions, Users' personal calendar, Display technology events and courses, and Focused learning pathways.



### Stack Overflow

Stack Overflow is a community-driven Q&A platform for programmers and developers, providing a space for developers to ask questions, share knowledge, and participate in discussions related to software development.[22]

-**Facilitation of Community-Wide Public Discussions:** On the Stack Overflow platform, users are allowed to engage in broader discussions and initiate conversations. Users can post general questions and foster community-wide engagement.

- **Personalized Recommendations:** On the Stack Overflow platform, it does not display questions and discussions based on interests. It instead tags topics separately, and the user can choose a tag and view related questions. These tags are chosen by the user when creating their account, this is more of a filtering mechanism rather than personalized recommendations. Additionally, when visiting a specific question, the platform offers a "related question" section, which acts as a recommender system by suggesting other relevant questions for further exploration.

**Features not Provided on Stack Overflow:** Post requests for collaboration, Freelancer

marketplace, Users' personal calendar, Display technology events and courses, and Focused learning pathways.



**GitHub**

GitHub is a platform for version control and collaboration, allowing developers to manage code repositories, track changes, and facilitate efficient collaboration among software development teams.[23]

**- Personalized Recommendations:** On the GitHub platform, the Explore section allows users to select their interested topics and then displays public repositories that align with the selected topics in the "Explore" section.

**- Version Control and Code Hosting:** On the GitHub platform, GitHub offers two unique features: version control, and code hosting, where developers can effectively manage and track changes in code repositories and provide a centralized location for developers to store, share, and collaborate on their projects.

**Features not Provided on GitHub:** Post requests for collaboration, Facilitation of community-wide public discussions, Freelancer marketplace, Users' personal calendar, Display technology events and courses, and Focused learning pathways.



**W3Schools**

W3Schools offers beginner-friendly tutorials, interactive examples, and practical exercises for web development, covering topics like web design, front-end development, and back-end development.[24]

**-Display Technology Courses:** On the W3School platform, it provides courses directly organized by their team. These courses not be free and it's require an access fee.

**-Focused Learning Pathways:** On the W3School, the platform creates pathways in- house by providing descriptions for code, tutorials, and quizzes. They offer a text- based approach and codes for topics related to web development, along with a code editor for users to run code in specific languages. W3Schools pathways do not include resources like articles, documents and projects.

**Features not Provided on W3Shcool:** Post requests for collaboration, Facilitation of community-wide public discussions, Freelancer marketplace, Personalized recommendations, Users' personal calendar, Display technology events.

### **Hackathonat**



platform aimed at assisting organizations in achieving their goals for competitions and challenges at the local, regional, and global levels.[25]

**- Post Requests for Collaboration for Facilitating Communication for Finding Individuals for Team Formation:** On the Hackathonat platform, here is a planned and visible feature for creating and assigning teams for hackathons, but it has not been activated yet.

**-Display Technology Events and Courses:** On the Hackathonat platform, the platform gathers and displays events and courses from various organizations, allowing users to access and explore events and courses from multiple sources.

**Features not Provided on Hackathonat:** Post requests for collaboration in fee- based project, Facilitation of community-wide public discussions, Freelancer marketplace, Personalized recommendations, Users' personal calendar.

### **ChatGPT**



ChatGPT is a conversational AI language model developed by OpenAI designed to generate human-like responses in natural language. It assists users by answering their questions and offering general help through natural language interactions.[26][27]

**- Engage & Connect:** ChatGPT enables users to engage in natural language interactions and have discussions with the ChatGPT bot, encouraging individual interactions rather than community-wide discussions.

**- Recommendations:** ChatGPT is not a recommendation system. While it can provide recommendations in the form of generated responses based on user input, its main purpose is to generate contextually relevant and coherent text based on the training it has received. It

does not specialize in personalized content recommendations based on individual preferences.

**Features not provided on ChatGPT:** Post requests for collaboration, Freelancer marketplace, Facilitate community-wide public discussions, Personalized recommendations using AI, Users' calendars, Private chat, Learning pathways, and Bookmarking.

Feature / competitors		TeXel	Upwork	Stack Overflow	GitHub	W3School	Hackathonat	ChatG PT
Post requests for:	Facilitating communication for finding individuals for team formation	Yes	No	No	No	No	Yes “Not activated yet”	No
	fee-based projects	Yes	Yes	No	No	No	No	No
Facilitation of community-wide public discussions by enabling users to post questions and answers.		Yes	No	Yes	No	No	No	No
Version control.		No	No	No	Yes	No	No	No
Freelancer marketplace.		Yes	Yes	No	No	No	No	No
Personalized recommendations.		Yes	Yes	Yes	Yes	No	No	Yes
Users' personal calendar.		Yes	No	No	No	No	No	No
Display technology events and courses.	Courses	Yes	No	No	No	Yes	Yes	No
	Event	Yes	No	No	No	No	Yes	No
Focused learning pathways		Yes	No	No	No	Yes	No	No
Code hosting.		No	No	No	Yes	No	No	No

Table 1: Competitive Product Analysis

In summary, the most significant and crucial feature of Texel is its ability to gather the most popular and widely used tools and tasks from various tech platforms into a one-in-all platform. This inclusive platform assists users by providing multiple tools and functions needed in their technical work instead of switching between different platforms. Texel provides a centralized and efficient platform for users to save valuable time and effort by accessing all their essential tools and resources in one place.

In addition to the comprehensive platform, Texel offers a unique recommendation system feature that sets it apart from its competitors. Firstly, it incorporates a recommendation system for community-wide public discussions for questions in the main feed, fostering meaningful interactions and knowledge sharing among users. This feature creates an engaging and collaborative environment, enhancing the user experience.

Furthermore, Texel includes another recommendation system specifically designed to display the best courses for each user. This personalized approach ensures that users have access to high-quality educational content tailored to their specific needs, providing them with a seamless learning experience.

## 4 System Design and Development

### 4.1 Methodology

Agile software development methodology was carefully selected as the most appropriate approach for this project, considering the ever-evolving nature of the requirements. This methodology, renowned for its adaptability and responsiveness, significantly emphasizes flexibility, open communication, and rapid iteration cycles. By embracing Agile principles, the development process is structured to incorporate a continuous feedback loop, enabling frequent adjustments and enhancements to be made seamlessly.

One of the prominent frameworks within the Agile methodology in TeXel project, is Scrum, recognized for its iterative nature and intense focus on fostering communication, teamwork, and collaboration among team members. Within the Scrum framework, there are three leading roles:

**The Product Owner:** our project supervisor Dr. Mashael Alsaleh, is responsible for defining the product backlog and prioritizing it based on business value.

**Scrum Master:** This person is responsible for facilitating the Scrum process and ensuring that everyone understands and follows the framework. They are also responsible for removing any obstacles that may prevent the team from delivering the product. In our project, we had Dr. Maha Alyahya as the scrum master.

**Development Team:** This is us, and we are responsible for delivering the product increment.

Moreover, there are five events in the Scrum framework:

**Sprint:** A time-constrained period, typically two to four weeks, within which the development team endeavors to deliver a product increment. Our project encompassed five sprints.

**Sprint Planning:** Commencing each sprint, the team convenes to strategize the tasks to be accomplished during the sprint duration. This involves a comprehensive review of the product backlog and selecting items earmarked for execution. Sprint planning sessions consistently involved the supervisor in a one-hour meeting at the onset of every sprint.

**Daily Scrum:** A brief 15-minute gathering wherein the team convenes to discuss progress and outline plans for the day's tasks.

**Sprint Review:** Upon the conclusion of each sprint, the team presents the product increment to stakeholders, seeking feedback and insights.

**Sprint Retrospective:** Following the conclusion of each sprint, the team convenes for a retrospective meeting to solicit input from all members regarding aspects that are functioning effectively and areas that need improvement.

In the Scrum framework, three artifacts are integral:

The Product Backlog is a list of all the features, enhancements, and bug fixes that need to be addressed in the product.

**Sprint Backlog:** this is a list of all the items the team plans to work on during the sprint.

**Increment:** This is the sum of all the product backlog items completed during the sprint.

By embracing agile principles, we effectively adapted to evolving requirements throughout the development lifecycle, ensuring frequent delivery of functional software. This approach prioritized simplicity, focusing on delivering the necessary features for the current phase. Supported by a self-organizing and motivated team that fosters regular communication and idea-sharing, we consistently delivered high-quality products, promoting robust architectures, requirements, and designs. Additionally, we leveraged the agile methodology and Scrum framework with the assistance of two essential tools: Jira<sup>1</sup> facilitated sprint planning, meeting notes recording, and product backlog management, while GitHub<sup>2</sup> facilitated seamless collaboration and tracking of changes across team members during each iteration.

<sup>1</sup> Jira: <https://jira.external-share.com/issue/bdc9bb7b-e3c8-44b7-82cf-8880bd7f9363>

<sup>2</sup> Github: <https://github.com/lina-tamim/2023-GP1-17>

## 4.2 System Requirements

### 4.2.1 System Users

Texel is designed to be inclusive and accessible to individuals from all walks of life. Users with diverse educational backgrounds and varying levels of professional experience can benefit from the features offered by Texel. We have gathered this understanding about our users through a survey, showing that Texel attracts both beginners embarking on their technology journey and advanced users seeking to expand their expertise. Also, Texel does not require any specific technical advanced knowledge since users only need to be proficient in using applications and English.

With valuable resources and opportunities, Texel is dedicated to helping users improve their skills and enhance their career prospects.

An admin will be responsible for managing the Texel platform to ensure its smooth functioning. The admin will have the necessary privileges and authority to monitor and maintain the platform, ensuring its security, stability, and overall performance.

### 4.2.2 Requirements Elicitation and Analysis

To elicit the requirements for our application " Texel," we analyzed similar systems and competitor applications in the market, such as stack overflow, GitHub, and Upwork, which helped us in identifying industry best practices, user and potential gaps that could be addressed in the Texel application. Additionally, we employed questionnaires as our chosen method. The questionnaire was distributed to 102 participants, serving as a means to gather valuable insights regarding user preferences and functionality. Analysis of similar systems and competitor applications in the market helped identify industry best practices, user expectations, and potential gaps that could be addressed in the Texel application.

#### **List of Questions:**

- 1- What is your age?
- 2- How would you rate your current technical proficiency?
- 3- Do you seek help on popular platforms like Stack Overflow when facing technical problems?

- 4- If yes, is it hard looking for resources to technical problems or inquiries?
  - 5- If yes, what platform do you use to find solutions?
  - 6- Can having a supportive community for public discussions and assistance help you find the information you need?
  - 7- Are you currently a member of any technical community?
  - 8- If yes, please mention the name of the community.
  - 9- Do you face difficulties finding collaboration opportunities, such as forming a team for hackathons or technology-related competitions?
  - 10- Have you previously engaged in collaboration with a freelancer, such as hiring them to complete a project or task for you?
  - 11- If yes, how did you find them?
  - 12- Are you interested in discovering the latest courses and events in your technology fields of interest?
  - 13- How do you typically find information about the latest events and courses?
  - 14- Have you ever used a platform to help you learn something new related to technology, such as: new tools, new skills, new programming language from A-Z?
  - 15- If yes, what platform did you use?
  - 16- How much time does it typically take you to find the right resources when learning a new technical skill or technology from A-Z?
  - 17- Imagine having an application that combines a variety of technology-related courses and events, a platform for asking questions and receiving community responses, and the opportunity to connect with individuals for collaborative projects. Would you be interested in using such an application?
- The questions above cover various dimensions, including user demographics, behavior on existing platforms, engagement with communities, collaboration experiences, learning habits, and receptiveness to the proposed features of Texel. The insights gained from these questions will be valuable for tailoring the platform to meet the diverse needs of our target users.

- **Survey Results and Analysis:**

Based on the responses we received, our survey revealed that most participants, particularly those aged 18-24, possess an intermediate level of experience in technology. Over 80% of individuals rely on online platforms to seek assistance and answers to their questions, and more than the half of them highlighted the challenge they face in finding resources for technical problems or inquiries. Stack Overflow, ChatGPT, and YouTube emerged as the most commonly used platforms for obtaining answers.

Furthermore, some respondents actively engage in various technology communities, such as the Flutter community and KSU CPC. Due to the diverse range of non-technical fields and specializations, almost 50% of the participants have utilized the services of freelancers to assist them with their projects, often relying on recommendations from others.

The survey results indicate a strong interest among respondents in discovering the latest courses and events within their respective technology fields. Social media platforms were identified as the primary source for accessing such information. Additionally, many participants have utilized online platforms like Udemy, W3Schools, Coursera, YouTube, and Udacity to acquire new technological skills.

According to the survey results, a significant majority of respondents (over 60%) reported spending between half a day to three days in their search for resources that met their needs. This indicates that the process of finding the right resources can be time and effort consuming. Conversely, only a small percentage (7%) of respondents claimed to have spent less than an hour in their resource search, highlighting the rarity of quickly finding solutions.

Finally, the survey findings reveal that most respondents highly desire a supportive community for public discussions and assistance. They expressed an interest in utilizing the Texel platform to meet their information-seeking needs.

Overall, the survey provides valuable insights into the preferences and challenges faced by respondents, highlighting the importance of reliable resources, community support, and platforms like Texel to enhance their technology-related experiences.

- **Implemented Features:**

Most of the features users mentioned and expressed a desire for in the survey is already implemented in Texel. The main features include users asking questions, requesting project help, viewing courses and events, chats, personalized content, quick access to learning

pathways, and more. Considering the survey feedback about people spending too much time finding solutions, Texel is adding a search feature to help users quickly find what they need. This way, the platform directly tackles the issues users mentioned in the survey.

- **Unimplemented Features:**

Some users mentioned features that still need to be implemented in Texel, including supporting the Arabic language and integrating the Slack platform. Given that Texel is designed for individuals interested in technology, and considering the global nature of the tech community, we assume that our target users typically have at least a basic understanding of the English language. As technology is a field with a strong emphasis on English for communication and documentation, our decision not to support Arabic now is based on the expectation that English proficiency is prevalent among our primary user base. Also, developing support for a new language, especially one with a different script like Arabic, requires additional resources in terms of time and manpower. If the development team has limitations, it might impact the decision. It's important to notice that Arabic is a right-to-left (RTL) script, which can introduce complexity regarding user interface design and coding. At the time, our development team initially focused on English to ensure a high-quality experience for users in English before expanding to other languages.

Slack integration is not currently supported in Texel for several reasons. Slack is primarily a team communication and collaboration tool, while Texel focuses on learning, collaboration, and networking within the technology community. Integrating Slack into Texel could deviate from the app's main purpose. It may also introduce technical complexities that need significant development resources, which could distract us from improving and enhancing the core features of Texel.

While Arabic support and Slack integration aren't currently offered, users' feedback is welcomed, and their suggestions will be reconsidered based on evolving needs.

The summary above provides an overview of the main findings and results. For more detailed information and additional data, please refer to the appendix on page number 125.

#### 4.2.3 User Interactions

- **Use case Diagram**



Figure 6: Texel's Usecase Diagram

#### 4.2.4 Roadmap and Product Backlog

- **Roadmap**

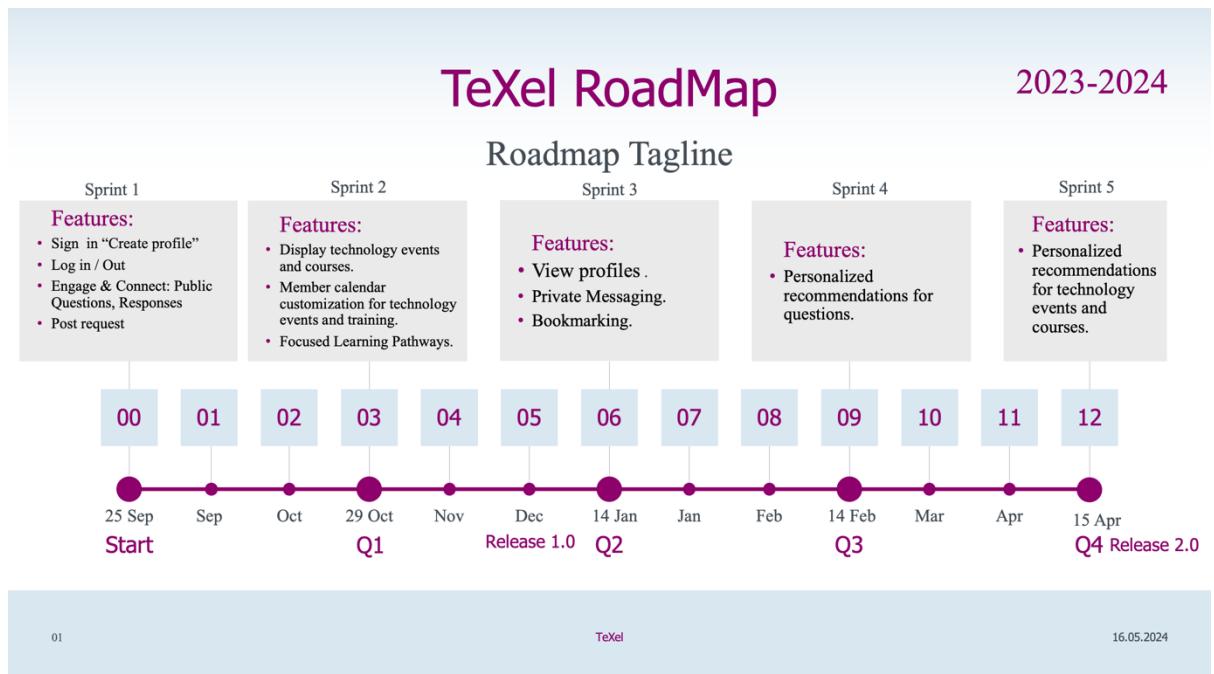


Figure 7: TeXel's Roadmap

- Product Backlog

ID	PBI	Size	Status	Type	Acceptance Criteria
1	As a new user, I want to create an account by filling out the registration form with profile image, username, email, password, country, city, state, type of user, preference on attendance, skills, interest and GitHub link so that I can join Texel platform.	2	Done	Feature	<p>-As a user, If I create my account successfully, then I will receive an indication that my account has been created and need a verification that send to registered email, and I will be redirected to the log in page.</p> <p>-As a user, If I miss a field and click on the create account button, then I will receive an indication to fill in the missing field/s.</p> <p>-As a user, If I enter an email address or username that is already associated with an existing account and click on create account button, then I will</p>

					<p>receive an indication to enter unused ones.</p> <p>-As a user, If I write an invalid input including a username that contains spaces or contains only digits or a username that is less than 6 characters, or a password less than 6 characters or contains spaces , or an email that does not consist of a valid email prefix and a valid email domain, or a GitHub link that does not consist of a valid prefix and click on the create account button, then I will receive an indication to correct the wrong field/s.</p>
2	As a user, I want to log in by filling out the log in form with email and password so that I can access my account in Texel platform.	2	Done	Feature	<p>-As a user, if click on the start button then I will be presented with a form to fill out my account information</p>

					<p>including my email and password.</p> <p>-As a user, if I enter my email and password correctly and click on the login button, then I will be redirected to the home page.</p> <p>-As a user, if I miss a field and click on the login button, then I will receive an indication to fill in the missing field/s.</p> <p>-As a user, If I enter an email and a password that don't match or non-registered email and click on login button, then I will receive an indication to use correct ones.</p>
3	As a user, I want to be able to reset my password when I forget it, so that I can access my account.	3	Done	Feature	<p>-As a user, if I click on the forgot password button in login page, then I will be able to enter my email.</p>

					<p>-As a user, if I enter my email and click on reset password now button, then I will receive an indication that a reset password email has been sent to me.</p> <p>-As a user, if I click on reset password link in the email I received, then I will be able to enter a new password.</p>
4	As a user, I want to log out from my account so that I can effectively end my session.	2	Done	Feature	<p>-As a user, if I click on the log out tab in the side navigation bar then I will receive an indication to confirm it.</p> <p>-As a user, if I confirm my logout by clicking on yes in the conformation message, then I will be redirected to the start page.</p> <p>-As a user, if I don't confirm my logout</p>

					by clicking on no, then I will stay on the same page.
5	As a user, I want to view my account so that I can check my personal information.	2	Done	Feature	<p>-As a user, if I click on the profile tab in the side navigation bar, then I will see my personal information including profile image, username, country, state, GitHub link, interests and skills</p>
6	As a user, I want to edit my account information including profile image, username, email, password, country, city, state, type of user , preference on attendance , skills , interest and GitHub link so that I can update my personal information.	2	Done	Feature	<p>-As a user, if I click on the edit button in profile page for my personal information, then I will be presented with a form where I can edit my information.</p> <p>-As a user, if I edit my information correctly and click on the save button, I will receive an indication that my information has been updated.</p> <p>-As a user, if I miss a field and click on the</p>

					<p>save button, then I will receive an indication to fill in the missing field/s.</p> <p>- As a user, If I write an invalid input including a username that contains spaces or contains only digits or a username that is less than 6 characters, or a password less than 6 characters or contains spaces , or an email that does not consist of a valid email prefix and a valid email domain, or a GitHub link that does not consist of a valid prefix and click on the create account button, then I will receive an indication to correct the wrong field/s.</p>
7	As a user, I want to delete my account so that I can permanently remove my personal information and	2	Done	Feature	<p>-As a user, If I click on the delete my account button, then I will receive an</p>

	discontinue my association with the platform.				indication to confirm it.  -As a user, If I confirm the deletion by clicking on delete, then I will be redirected to the sign-up page and my account will be removed permanently.  -As a user, if I don't confirm the deletion by clicking on cancel, then I will stay on the same page and my account will remain in the platform.
8	As a user, I want to post a question so that I can get responses from other users.	3	Done	Feature	-As a user, if I click on the add button in the home page, then I will be able to choose to add a question.  -As a user, if I choose to add a question, then I will fill in the required fields including title,

					skill/s and question description.  -As a user, If I click on the post button, then I will receive an indication that my question has been sent and can be seen in the main page.  -As a user, If I miss a field, then I will receive an indication to fill in the missing field/s.  -As a user, if I exceed the characters limit which is 1024 characters, then I will receive an indication that I have exceeded the character's limit.
9	As a user, I want to delete a question I posted so that it will be removed from the platform permanently.	3	Done	Feature	-As a user, if I click on the delete button in my interaction page for question section, then I will receive an indication to confirm it.

					<p>-As a user, If I confirm the deletion by clicking on delete, then it will be removed from the platform permanently along with any associated answers.</p> <p>-As a user, if I don't confirm the deletion by clicking on cancel, then my question will remain in the platform.</p>
10	As a user, I want to search for questions by writing my own question so that I can discover similar questions related to my query.	3	Done	Feature	<p>-As a user, if I click on the search bar in home page for question section, then I will be able to write my question.</p> <p>-As a user, if I search for a question that exists, then I will see relevant and similar questions that match my search query.</p> <p>-As a user, if I search for a question that doesn't exist, then I will receive an</p>

					indication that no matching questions exists.
11	As a user, I want to answer users' questions so that I can contribute to the community and help others find the information they need.	3	Done	Feature	<p>-As a user, if I click on the answer button for a question, then I will redirect to answers page and fill in the required answer field.</p> <p>-As a user, If I click on the submit button, then I will receive an indication that my answer has been sent and can be seen with the question.</p> <p>-As a user, If I miss the answer field, then I will receive an indication to fill out in the missing field.</p> <p>-As user, if I exceed the characters limit which is 1024 characters, then I will receive an indication that I have exceeded the character's limit.</p>
12	As a user, I want to delete my answers to users' questions so	3	Done	Feature	-As a user, if I click on the delete button

	that I can remove them from the platform.				<p>in my interaction page -question section, then I will receive an indication to confirm it.</p> <p>-As a user, If I confirm the deletion by clicking on delete, then my answer will be removed permanently.</p> <p>-As a user, if I don't confirm the deletion by clicking on cancel, then my answer will remain in the platform.</p>
13	As a user, I want to upvote a user response so that I can show agreement with the valuable information provided by another user.	5	Done	Feature	<p>-As a user, if I click on the upvote button for a user response, then my upvote will be counted and the response's votes will be updated.</p> <p>-As a user, if I re-click on the upvote button then my voting will be removed, and the response's votes</p>

					number will be updated.
14	As a user, I want to post a collaboration request so that other users can see my request and I can find individuals who have the skills needed to assist with a specific task.	3	Done	Feature	<p>-As a user, if click on the add button in the home page, then I will be able to choose to add a request.</p> <p>-As a user, if I click on the add button in the home page for request, then I will be presented with a form to fill out the fields including type, title, skill/s, description, and the deadline date.</p> <p>-As a user, If I miss a field, then I will receive an indication to fill in the missing field/s.</p> <p>-As a user, If I click on the submit button, then I will receive an indication that it has been sent and can be seen in the main page.</p>

					<p>-As user, if I exceed the characters limit which is 1024 characters, then I will receive an indication that I have exceeded the character's limit.</p>
15	As a user, I want to delete my request so that I can remove it from the platform permanently.	3	Done	Feature	<p>-As a user, if I click on the delete button in my interaction page - build team request or project section, then I will receive an indication to confirm it.</p> <p>-As a user, if I confirm the deletion by clicking on delete, then my request will be removed from the platform.</p> <p>-As a user, if I don't confirm the deletion by clicking on cancel, then my request will remain in the platform.</p>
16	As a user, I want to search for collaboration request posts by	3	Done	Feature	-As a user, if I click on the search bar in home page, then I

	title, so that I can find what I'm looking for.				<p>will be able to write the desired collaboration post title.</p> <p>-As a user, if I search for a post that exists, then I will see it.</p> <p>-As a user, if I search for a collaboration post that doesn't exist, then I will receive an indication that it doesn't exist.</p>
17	As a user, I want to view my questions, answers and posted collaboration request so that I can review my previous interactions and have a record of the discussions I have participated in.	3	Done	Feature	<p>-As a user, if I click on my interactions tab in the side navigation bar, I will see my previous interactions including questions and answers and posted collaboration requests including build team and projects.</p>
18	As a user, I want to view a list of upcoming technology events and courses so that I can stay updated on the latest opportunities.	3	Done	Feature	<p>-As a user, if I click on the courses and events tab in explore page, then I will be redirected to it.</p>

19	As a user, I want to know more information about a course/event so that it redirects me to the organization providing the course/event.	3	Done	Feature	<p>-As a user, if I click on more details button in course and event page, then I will be redirected to the source of the course/event.</p>
20	As a user, I want to search for courses/events by title, so that I can find what I'm looking for.	3	Done	Feature	<p>-As a user, if I click on the search bar in explore page for courses and event section, then I will be able to write the desired course/event title.</p> <p>-As a user, if I search for a course/event that exists, then I will see it.</p> <p>-As a user, if I search for a course/event that doesn't exist, then I will receive an indication that it doesn't exist.</p>
21	As a user, I want to post a course or event to share valuable information and opportunities with the Texel community.	3	Done	Feature	<p>-As a user, if I click on the add button in the explore page, then I will be presented with form</p>

					<p>to fill out the course/event information including type, title, start date, end date , location, description, online or onsite option and a link for the platform of the source of the course/event.</p> <p>-As a user, if I post course/event correctly by clicking on the submit button, then I will receive an indication that the course/event has been sent and it will be sent for admin approval.</p> <p>-As a user, if I miss a field and click on the submit button, then I will receive an indication to fill in the missing field/s.</p> <p>-As a user, if I enter incorrect information including old end</p>
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					dates, invalid link prefix or domain and click on the submit button, then I will receive an indication to correct the wrong field/s.
22	As a user, I want to check the status of a course or event I have uploaded so that I can know if it was rejected or accepted by admin.	5	Done	Feature	-As a user, If I click on my requests tab in course and event page, I will be able to check the status of the course/event I have submitted.
23	As a user, I want to add a course or an event to my calendar so that I can easily keep track of upcoming schedules.	3	Done	Feature	-As a user, if I click on the add to my calendar icon button on the course or event, then I will receive an indication that it has been added and it will be added.
24	As a user, I want to view my calendar to stay organized and manage my schedule effectively.	2	Done	Feature	-As a user, if I click on my calendar tab, then I will see my calendar with my added events/courses.
25	As a user, I want to delete courses and events from my calendar so that I can remove any unwanted items.	3	Done	Feature	- As a user, if I click on the delete button for the desired day on the calendar page,

					then the course/event will be removed from the calendar.
26	As a user, I want to view learning pathways so that I can discover organized educational routes that guide me towards achieving specific skills.	3	Done	Feature	<ul style="list-style-type: none"> <li>- As a user, if I click on the pathways tab in explore page, then I will be able to browse and view various learning pathways, including the pathway title, pathway description, and key topics included in it</li> </ul>
27	As a user, I want to view learning pathway details so that I can explore and expand each pathway's content.	3	Done	Feature	<ul style="list-style-type: none"> <li>- As a user, if I click on the explore button for pathway, then I will be able to discover more content of the pathway, including the pathway title, pathway description, list of subtopics, their description, and resource.</li> <li>- As a user, if I click on the arrow icon button, then I will be able to discover each subtopics description and resource.</li> </ul>

28	As a user, I want to search for pathways by title, so that I can find the pathway match what I'm looking for.	3	Done	Feature	<p>-As a user, if I click on the search bar in explore page for pathway section, then I will be able to write the desired pathway title.</p> <p>-As a user, when I search for a title that exists, then I will see the relevant pathways.</p> <p>-As a user, if I search for a title that doesn't exist, then I will receive an indication that no matching pathways exists.</p>
29	As a user, I want to view other users' profiles so that I can learn more about them and establish connections within the community.	3	Done	Feature	<p>-As a user, if I click on a specific user, then I will be redirected to their profile.</p> <p>-As a user, if I want to contact a user, then there should be a private chat button to communicate with the user privately.</p>

30	As a user, I want to browse through the freelancer page so that I can view available freelancers and view their profiles to find the right individuals for my project or task.	3	Done	Feature	<p>-As a user, if I click on the freelancer's tab, then I will be redirected to the freelancer page and will see all freelancers with their information.</p> <p>-As a user, if I click on a specific freelancer, then I will be redirected to their profile.</p> <p>-As a user, if I want to contact a freelancer, then there should be a private chat button to communicate with the freelancer privately.</p>
31	As a user, I want to search for users by username, so that I can find users I'm looking for.	3	Done	Feature	<p>-As a user, if I click on the search bar, then I will be able to write the desired username.</p> <p>-As a user, if I search for a username that exists, then I will see the account</p>

					<p>associated with the username.</p> <p>-As a user, if I search for a username that doesn't exist, then I will receive an indication that it doesn't exist.</p>
32	As a user, I want to view my private chats so that I can revisit my previous chats.	3	Done	Feature	<p>-As a user, if I click on the private chats tab, then I will be redirected to the private messages page and I will see all my previous chats.</p> <p>-As a user, if I click on a specific chat or conversation, then I will see the entire message history of that conversation.</p>
33	As a user, I want to be able to contact other users by private chat, so that I can communicate with them easily and find opportunities to contribute my expertise to their projects or tasks.	5	Done	Feature	<p>-As user, if click on the private chat button on a collaboration request, then I will be redirected to the user's private chat.</p>

					<p>-As a user, if I click on the private chat button on a user profile, then I will be redirected to the user's private chat.</p> <p>-As a user, if I click on the desired chat in the chat page, then I will be able to communicate with that user.</p>
34	As a user, I want to bookmark a question so that I can save it for future reference and easily revisit it later.	3	Done	Feature	<p>-As a user, if I click on the bookmark button on a question, then I will receive an indication that it has been saved and it will be added to the bookmark section.</p> <p>-As a user, if I re-click the bookmark button then it will remove the saved post from bookmark section.</p>
35	As a user, I want to bookmark a pathway so that I can save it for future reference and easily revisit it later.	3	Done	Feature	<p>-As a user, if I click on the bookmark button on a pathway, then I will receive an indication that it has</p>

					<p>been saved and it will be added to the bookmark section.</p> <p>-As a user, if I re-click the bookmark button then it will remove the saved post from bookmark section.</p>
36	As a user, I want to be able to report inappropriate posts or accounts so that I can help maintain the integrity and safety of the platform.	3	Done	Feature	<p>-As a user, if I click on the report button, then I will be presented with a list of violations.</p> <p>-As a user, if I choose the type of report, then I will receive an indication that it has been sent.</p>
37	As a user, I want the questions to be ordered based on recommendations so that I can easily discover relevant and personalized content.	5	Done	Feature	<p>-As a user, if I open the main page, then I will see questions relevant to me.</p>
38	As a user, I want the courses and events to be ordered based on recommendations so that I can easily discover relevant and personalized content.	5	Done	Feature	<p>-As a user, if I open the courses and events section, then I will see courses and events relevant to me</p>

39	As an admin, I want to log in so that I can access my account in Texel platform.	2	Done	Feature	<p>-As an admin, if I log in to my account by entering my email and password successfully, then I will be redirected to the admin dashboard page.</p> <p>-As an admin, if I miss a field and click on the login button, then I will receive an indication to fill in the missing field/s.</p> <p>-As an admin, If I enter an email and a password that don't match or non-registered email and click on login button, then I will receive an indication to use correct ones.</p>
40	As an admin, I want to log out so that I can effectively end my session.	2	Done	Feature	<p>-As an admin, If I click on the log out tab in the side navigation bar, then I will receive an indication to confirm it.</p>

					<p>-As an admin, if I confirm my logout by clicking on yes, then I will be redirected to the login page.</p> <p>-As a user, if I don't confirm my logout by clicking on no, then I will stay on the same page.</p>
41	As an admin, I want to view my account so that I can check my information and role.	2	Done	Feature	<p>-As an admin, if I click on profile tab in the side navigation bar, then I will see my information including my role.</p>
42	As an admin, I want to edit my account so that I can change my password.	2	Done	Feature	<p>-As an admin, if I click on the edit button in profile page, then I will be presented with a form where I can change my password.</p> <p>-As an admin, if I change my password correctly and click on the save button, then I will receive an indication that my</p>

					<p>password has been changed.</p> <p>-As an admin, if I miss the password field and click on the save button, then I will receive an indication to fill in the password field.</p> <p>-As an admin, if I enter incorrect password including a weak password, and click on the save button, then I will receive an indication to correct the wrong password.</p>
43	As an admin, I want to be able to reset my password when I forget it, so that I can access my account.	3	Done	Feature	<p>-As an admin, if I click on the forgot password button in login page, then I will be able to enter my email.</p> <p>-As an admin, if I enter my email and click on reset password button, then I will receive an indication that a reset</p>

					<p>password email has been sent to me.</p> <p>-As an admin, if I click on reset password link in the email I received, then I will be able to enter a new password.</p>
44	As an admin, I want to post courses and events so that I can provide users with an up-to-dated list of available courses and events.	3	Done	Feature	<p>-As an admin, if I click on the add button in admin course and event management page, then I will be presented with form to fill out the course/event information including type, title, start date, end date , location, description, online or onsite option and a link for the platform of the source of the course/event.</p> <p>-As an admin, if I post the course/event successfully, then I will receive an indication that the</p>

					<p>course/event has been posted and can be seen in the events and courses page.</p> <p>-As an admin, if I miss a field and click on the submit button, then I will receive an indication to fill in the missing field/s</p> <p>-As an admin, if I enter incorrect information including old end dates, invalid link prefix or domain and click on the submit button, then I will receive an indication to correct the wrong field/s.</p>
45	As an admin, I want to view a list of upcoming technology events and courses so that I can check and monitor the added courses and events.	2	Done	Feature	<p>-As an admin, if I click on the events and courses tab in explore page, then I will be redirected to it.</p>
46	As an admin, I want to edit posted courses and events so	3	Done	Feature	<p>-As an admin, if I click the edit button in admin course and</p>

	<p>that I can ensure accurate information.</p>			<p>event management page for edit the course/event, then I will be presented with the course/event information type, title, start date, end date, location, description, online or onsite option and a link for the platform of the source of the course/event. to change it.</p> <p>-As an admin, if I enter incorrect like old end dates, invalid link prefix or domain and click on the submit button, then I will receive an indication to correct the wrong field/s.</p> <p>-As an admin, if I miss a field, then I will receive an indication to fill in the missing field/s.</p> <p>-As an admin, if I edit the course/event</p>
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					information successfully, then I will receive an indication that the course/event information has been updated.
47	As an admin, I want to delete courses and events so that I can remove outdated or canceled courses and events.	3	Done	Feature	<ul style="list-style-type: none"> <li>-As an admin, If I click on the delete button in admin courses and events management page, then I will receive an indication to confirm it.</li> <li>-As an admin, If I confirm the deletion of event/course by clicking on delete, then I receive an indication that it has been deleted.</li> <li>-As an admin, If I deleted the course/event successfully, then it will be removed from the platform.</li> <li>-As an admin, if I don't confirm the deletion of</li> </ul>

					event/course by clicking on cancel, then I will remain on the same page.
48	As an admin, I want to search for courses/events by title, so that I can find what I'm looking for.	3	Done	Feature	<p>-As an admin, if I click on the search bar in admin courses and event management page or in user course and event addition request, then I will be able to write the desired course/event title.</p> <p>-As an admin, if I search for a course/event that exists, then I will see it.</p> <p>-As an admin, if I search for a course/event that doesn't exist, then I will receive an indication that it doesn't exist.</p>
49	As an admin, I want to post learning pathways so that I can provide users with structured learning journeys.	5	Done	Feature	-As an admin, if I click on the add button in admin pathway

					<p>management, then I will be presented with a form to fill the pathway information including the pathway title, pathway description, and key topics, subtopics, subtopics description and subtopics resources.</p> <p>-As an admin, if I miss a field, then I will receive an indication to fill in the missing field/s.</p> <p>-As an admin, if I enter a pathway title that already exist, then I will receive indication to correct the wrong field.</p> <p>-As an admin, if I exceed the characters limit of main title which is 40 characters, then I will receive an indication that I have exceeded the character's limit.</p>
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					<p>-As an admin, if I exceed the characters limit of description which is 250 characters, then I will receive an indication that I have exceeded the character's limit.</p> <p>-As an admin, if I post a pathway correctly, then I will receive an indication that the pathway has been added and can be seen in the pathways page.</p>
50	As an admin, I want to view the learning pathways so that I can check and monitor the posted pathways.	2	Done	Feature	<p>- As an admin, if I click on the admin pathways management, then I will be able to browse and view various learning pathway including the pathway title, pathway description, and key topics included in it</p>
51	As an admin, I want to view learning pathway details so that I can explore and expand each pathway's content.	3	Done	Feature	<p>- As an admin, if I click on the explore button for pathway, then I will be able to</p>

					<p>discover more content of the pathway, including the pathway title, pathway description, list of subtopics, their description, and resource.</p> <p>- As an admin, if I click on the arrow icon button for pathway, then I will be able to discover each subtopics description and resource.</p>
52	As an admin, I want to edit learning pathways so that I can update and refine the content, structure, or sequencing of the learning materials.	3	Done	Feature	<p>-As an admin, if I click on the edit button in admin pathways management, then I will be presented with the pathway information form including pathway title, pathway description, and key topics, subtopics, subtopics description and subtopics resources to change it.</p>

					<p>-As an admin, if I miss a field, then I will receive an indication to fill in the missing field/s.</p> <p>-As an admin, if I enter a pathway title that already exist, then I will receive indication to correct the wrong field.</p> <p>-As an admin, if I exceed the characters limit of main title which is 40 characters, then I will receive an indication that I have exceeded the character's limit.</p> <p>-As an admin, if I exceed the characters limit of description which is 250 characters, then I will receive an indication that I have exceeded the character's limit.</p>
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					-As an admin, if I edit a pathway correctly, then I will receive an indication that the pathway has been updated.
53	As an admin, I want to delete learning pathways so that I can remove redundant or duplicate learning pathways.	3	Done	Feature	<p>-As an admin, If I click on the delete button in admin pathways management, then I will receive an indication to confirm it.</p> <p>-As an admin, If I confirm the deletion by clicking on delete, then I will receive an indication that the pathway information has been deleted it will be removed permanently.</p> <p>-As an admin, if I don't confirm the deletion by clicking on cancel, then the pathway will remain in the same page.</p>
54	As an admin, I want to search for pathways by title, so that I	3	Done	Feature	-As an admin, if I click on the search

	can find the pathway match what I'm looking for.				bar in admin pathways management page, then I will write the desired pathway title.  -As an admin, when I search for a title that exists, then I will see the relevant pathways.  -As an admin, if I search for a title that doesn't exist, then I will receive an indication that no matching pathways exists.
55	As an admin, I want to check users' requests for posting a course or event so that I can review and approve qualified submissions	5	Done	Feature	-As an admin, If I click on the user course or event addition request button, then I will see the users' submitted requests.  -As an admin, If I accept a user's request, the course/event will be added to the courses and events page and

					<p>the request will disappear from my requests page.</p> <p>-As an admin, If I reject a user's request, I need to justify rejection and the request will disappear from my requests page.</p>
56	As an admin, I want to view users' reported posts and accounts so that I can take necessary actions on reported issues.	5	Done	Feature	<p>-As an admin, if I click on the reports tab, then I will be able to check users' reports.</p> <p>-As an admin, if I click on a specific report, then I will be able to view the reported post or account.</p>
57	As an admin, I want to delete inappropriate reported posts so that I can help maintain the integrity and safety of the platform.	3	Done	Feature	<p>-As an admin, if I click on the accept button of a reported post, then I will receive an indication to confirm deletion of the post.</p> <p>-As an admin, if I confirm the deletion</p>

					<p>by clicking on confirm, then the post will be deleted from the platform.</p> <p>-As an admin, if I accept the report of a post successfully, then any related interactions will be removed.</p> <p>-As an admin, if I don't confirm the deletion by clicking on cancel, then the post will remain on the platform.</p>
58	As an admin, I want to send warnings to reported accounts so that I can help maintain the integrity and safety of the platform.	3	Done	Feature	<p>-As an Admin, if I accept a reported account, then a warning email will be sent to the user.</p> <p>-As an admin, if I reject a reported account, then the account will not be affected.</p>
59	As an admin, I want to search for reported collaboration posts by title, so that I can find what I'm looking for.	3	Done	Feature	<p>-As an admin, if I click on the search bar, then I will be able to write the</p>

					<p>desired reported post title.</p> <p>-As an admin, if I search for a reported post that exists, then I will see it.</p> <p>-As an admin, if I search for a reported post that doesn't exist, then I will receive an indication that it doesn't exist.</p>
60	As an admin, I want to search for reported users by username, so that I can find users I'm looking for.	3	Done	Feature	<p>-As an admin, if I click on the search bar, then I will be able to write the desired username.</p> <p>-As an admin, if I search for a username that is reported and exists, then I will see the account associated with the username.</p> <p>-As an admin, if I search for a username that is not reported or doesn't exist, then I will</p>

					receive an indication that it doesn't exist.
61	As an admin, I want to search for reported questions by writing my own question so that I can find the question I'm looking for.	3	Done	Feature	<p>-As an admin, if I click on the search bar, then I will be able to write my question.</p> <p>-As an admin, if I search for a reported question that exists, then I will see relevant and similar questions that match my search query.</p> <p>-As an admin, if I search for a reported question that doesn't exist, then I will receive an indication that no matching questions exists.</p>
62	As an admin, I want to view other users' profiles so that I can track users accounts.	3	Done	Feature	-As an admin, if I click on a specific user, then I will be redirected to their profile.
63	As a user, I want the platform to be simple and clear where my training time to use it does not require more than 1	Non-functional requirements are not	Done	Feature	-As a user, if I access the platform, then I will easily navigate it

	hour, so that I can quickly navigate the platform and start utilizing its features effectively.	assigned a specific size since they are implemented as part of the overall process.			and use it within 1 hour of training.
64	As a user, I want the app to handle errors efficiently and provide clear and error messages, so that I can understand what went wrong and take appropriate action.	Done	Feature	-As a user, if I encounter an error in the app, then I will see clear and descriptive error message that helps me understand the issue and guides me towards the appropriate action.	
65	As a user, I want my password to be stored securely using encryption techniques, so that my password remains protected.	Done	Feature	-As a user, if I provide a password during registration or when changing my password, then it will be securely stored using encryption techniques.	
66	As a user, I want the application to be available 99% of the times I try to access it, so that I can access the application at any time I need it.	Done	Feature	-As a user, if I want to access the application, I expect it to be 99% of the time available.	
67	As an admin, I want to have higher permissions than regular users, so that regular	Done	Feature	-As an admin, if I log into the system, then I expect to have	

	users are restricted from accessing sensitive functions.				higher permissions that grant me access to sensitive functions and restrict regular users from accessing those functions.
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Table 2: TeXel's Product Backlog

We have no deleted or unaccomplished user stories; all the user stories we planned for are completed.

## 4.3 System Design

### 4.3.1 Architectural Diagram

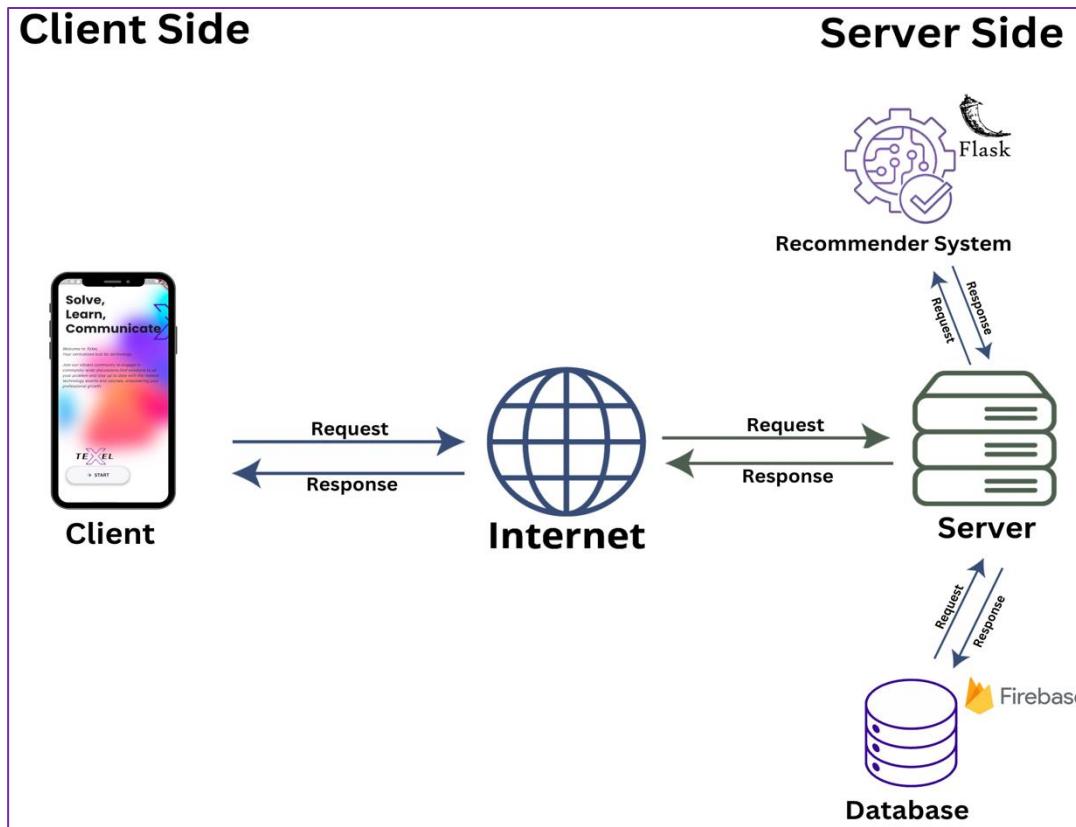


Figure 8: Texel's Client-Server Architecture

In the client-server architecture of Texel, the application is divided into two primary components: the client and the server. The client side, residing on the user's device, manages the user interface and includes elements such as user interface components, user input mechanisms, and client-side logic for rendering and processing data. On the other hand, the server side, running on a remote machine, handles the application's data and business logic. It comprises the server application, database management system, recommendation system, and server-side logic for processing client requests, retrieving or manipulating data, and ensuring data consistency.

When a client initiates a request, it is transmitted to the server for processing. The server interacts with the database and recommendation system, as necessary, to retrieve or manipulate the data. We chose the client-server model for Texel due to its scalability and flexibility, enabling multiple clients to access the application's data and functionality concurrently, regardless of their geographic location. Furthermore, Texel incorporates a recommender system that utilizes AI algorithms on the server side. This system plays a vital role in providing

personalized recommendations and enhancing user experience based on their preferences and behavior.

The core functions of Texel, universally accessible to all clients with an internet connection, operate seamlessly through Firebase, a cloud-based platform. Whenever a client requests an interface, information, or a specific function, the server promptly responds by leveraging the Firebase database. Additionally, when required, the recommendation system algorithm is invoked through a Flask server to ensure optimal user experience and satisfaction.

#### 4.3.2 Class Diagram /DFD

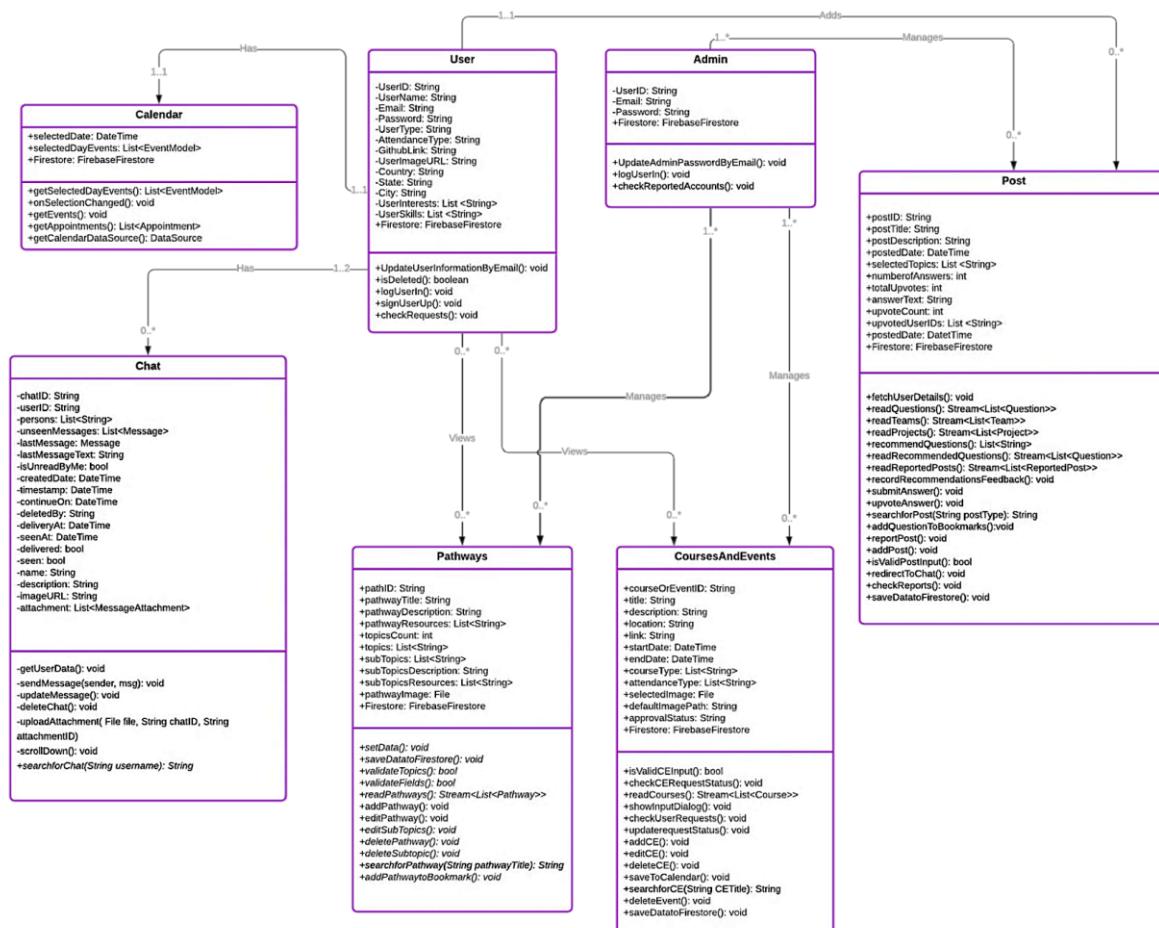


Figure 9: TeXEL's Class Diagram

The class diagram shows a high-level structure of Texel's application, illustrating the interactions between key roles and main components. It presents an overview of the main attributes and methods associated with each class, highlighting their relationships. The diagram

serves as a visual representation of the system's architecture and aids in understanding the overall design and functionality of Texel.

The class diagram shows a high-level structure of Texel 's application, illustrating the interactions between key roles and main components. It presents an overview of the main attributes and methods associated with each class, highlighting their relationships. The diagram serves as a visual representation of the system's architecture and aids in understanding the overall design and functionality of Texel.

#### 4.3.3 Component Level Design

- Submit Posts:

Allowing users to submit posts such as questions, team collaborations, or project requests publicly, encourages knowledge sharing and collaboration within the community.

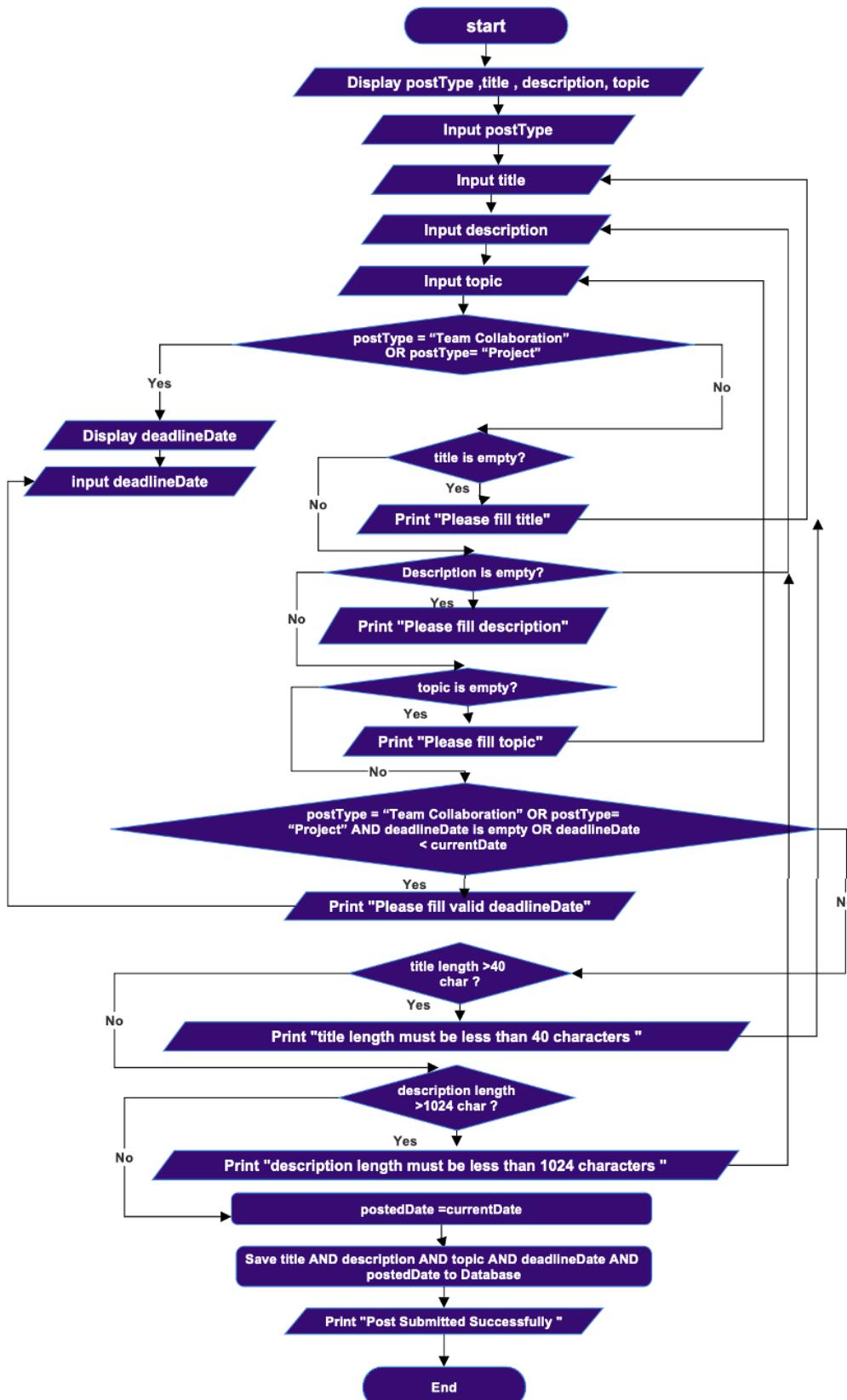


Figure 10: Flowchart for Submitting a Post

The value 1024 has been assigned as the length for the post description, as it is known in Firebase that the length of the input should not exceed 1024 characters.

- **Content-Based Recommender System for Question**

This pseudo code is a recommendation system that takes in user information, and a list of questions, and returns a list of recommended questions that are most relevant to the user. The system uses a combination of TF-IDF vectorization, cosine similarity, and weighted scoring to rank the questions based on their topics, upvotes, answers, and posting dates.

- Client-side:

```

questionsJson = empty list
FOR EACH question in allTheQuestions:
    jsonQuestion = new map
    jsonQuestion['questionTopics'] = question['questionTopics']
    jsonQuestion['noOfAnswers'] = question['noOfAnswers']
    jsonQuestion['questionID'] = question['questionID']
    jsonQuestion['totalUpvotes'] = question['totalUpvotes']
    jsonQuestion['postedDate'] = question['postedDate']
    ADD jsonQuestion TO questionsJson

FUNCTION recommendQuestions(questionsJson)
    requestBody = new map
    requestBody['user_skills'] = userSkills
    requestBody['user_interests'] = userInterests
    requestBody['all_questions'] = questionsJson
    SEND HTTP POST REQUEST TO DEPLOYED FLASK RECOMMENDATION API WITH:
        headers = { 'Content-Type': 'application/json; charset=UTF-8' }
        body = encode requestBody AS JSON
    RESPONSE = WAIT FOR RESPONSE
    IF RESPONSE STATUS CODE IS 200 THEN
        responseBody = decode RESPONSE BODY AS JSON
        recommendedQuestionIDs = empty list
        FOR EACH item IN responseBody:
            ADD item TO recommendedQuestionIDs
    DISPLAY recommendedQuestionIDs

```

- Server-Side:

```

DEFINE app AS Flask Application
DEFINE recommendRoute AS ROUTE FOR /
    INPUT request AS JSON OBJECT
    userSkills = request['user_skills']
    userInterests = request['user_interests']
    questionsDF = request['all_questions']
    recommendedQuestionsIDs = RecommendQuestions(userSkills, userInterests, questionsDF)
    RETURN JSON RESPONSE WITH recommendedQuestionsIDs

```

```

FUNCTION RecommendQuestions(userSkills, userInterests, questionsDF)
    questionsData = ExtractFeatures(questionsDF)

```

**RETURN** Recommend(questionsData, userSkills, userInterests)

**FUNCTION** ExtractFeatures(questionsDF)

```

questionIDs = []
questionTopics = []
totalUpvotes = []
noOfAnswers = []
postedDates = []

FOR EACH question IN questionsDF:
    questionIDs.append(question['questionId'])
    questionTopics.append(question['selectedTopics'])
    totalUpvotes.append(question['totalUpvotes'])
    noOfAnswers.append(question['noOfAnswers'])
    postedDates.append(question['postedDate'])

data = { 'questionID': questionIDs,
         'questionTopics': questionTopics,
         'totalUpvotes': totalUpvotes,
         'noOfAnswers': noOfAnswers,
         'postedDate': postedDates }

RETURN data

```

**FUNCTION** Recommend(questionsData, userSkills, userInterests)

```

userInput = CombineUserSkillsAndInterests(userSkills, userInterests)
similarityScores = CalculateSimilarity(userInput, questionsData)
weightedSimilarity = CalculateWeightedSimilarity(similarityScores, questionsData)

RETURN GetTopRecommendedQuestions(weightedSimilarity, questionsData)

```

**FUNCTION** CalculateSimilarity(userInput, questionsData)

```

vectorizer = TfidfVectorizer()
userTfidfMatrix = vectorizer.transform([userInput])
questionsTfidfMatrix = vectorizer.transform(questionsData['questionTopics'])
similarityScores = COSINE_SIMILARITY(userTfidfMatrix, questionsTfidfMatrix)

RETURN similarityScores

```

**FUNCTION** CalculateWeightedSimilarity(similarityScores, questionsData)

```

weights = { 'questionTopics': 0.5,
            'totalUpvotes': 0.1,
            'noOfAnswers': 0.2,
            'daysSincePosted': 0.4 }

questionsData['normalizedUpvotes'] = questionsData['totalUpvotes'] / MAX(questionsData['totalUpvotes'])
questionsData['normalizedAnswers'] = questionsData['noOfAnswers'] / MAX(questionsData['noOfAnswers'])
questionsData['daysSincePosted'] = (CURRENT_DATE() - questionsData['postedDate']).days
questionsData['weightedDaysSincePosted'] = EXP(-questionsData['daysSincePosted'] /
                                              MAX(questionsData['daysSincePosted']))

weightedSimilarity = (similarityScores * weights['questionTopics']) +
                     (questionsData['normalizedUpvotes'] * weights['totalUpvotes']) +
                     (questionsData['normalizedAnswers'] * weights['noOfAnswers']) +
                     (questionsData['weightedDaysSincePosted'] * weights['daysSincePosted'])

RETURN weightedSimilarity

```

```

FUNCTION GetTopRecommendedQuestions(weightedSimilarity, questionsData)
    sortedIndices = SORT(weightedSimilarity, DESCENDING)
    recommendedQuestionIDs = []
    FOR EACH index IN sortedIndices:
        questionID = questionsData[index]['questionID']
        recommendedQuestionIDs.append(questionID)
        IF LENGTH(recommendedQuestionIDs) == 10 THEN
            BREAK
    RETURN recommendedQuestionIDs

```

- **Hybrid Recommender System for Courses and Events**

This pseudo code is a recommendation system that takes in user information and a list of courses/events, and returns a list of recommended courses/events that are most relevant to the user. The system uses TF-IDF vectorization, cosine similarity, and weighted scoring to rank the courses/events based on factors like attendance preferences, location, as well as similar users' interactions.

- Client-side:

```

LET currentUserEmail BE current active user
LET allCEs BE all courses and events stored in database
CEJson = empty list
FOR EACH program IN allCEs:
    jsonCE = new map
    jsonCE['CourseEventID'] = program['CourseEventID']
    jsonCE['attendanceType'] = program['attendanceType']
    jsonCE['country'] = program['country']
    jsonCE['state'] = program['state']
    jsonCE['city'] = program['city']
    jsonCE['clickedBy'] = program['clickedBy']
    ADD jsonCE TO CEJson

```

```

LET allUsers BE all users stored in database
usersJson = empty list
FOR EACH user IN allUsers
    jsonUser = new map
    jsonUser['email'] = user['email']
    jsonUser['interests'] = user['interests']
    jsonUser['skills'] = user['skills']
    jsonUser['attendancePreference'] = user['attendancePreference']
    jsonUser['country'] = user['country']
    jsonUser['state'] = user['state']
    jsonUser['city'] = user['city']
    ADD jsonUser TO usersJson

```

```

FUNCTION recommendCE(currentUserEmail, usersJson, CEsJson)
    requestBody = new map
    requestBody['userEmail'] = currentUserEmail
    requestBody['allUsers'] = usersJson
    requestBody['allCE'] = CEsJson

SEND HTTP POST REQUEST TO DEPLOYED FLASK RECOMMENDATION API WITH:
    headers = { 'Content-Type': 'application/json; charset=UTF-8' }
    body = encode requestBody AS JSON

RESPONSE = WAIT FOR RESPONSE
IF RESPONSE STATUS CODE IS 200 THEN
    responseBody = decode RESPONSE BODY AS JSON
    recommendedCEIDs = empty list
    FOR EACH item IN responseBody:
        ADD item TO recommendedCEIDs
    DISPLAY recommendedCEIDs

```

- Server-Side:

```

DEFINE app AS FlaskApplication
DEFINE recommendCE AS ROUTE FOR /recommendCE
    INPUT request AS JSONOBJECT
        userEmail = request['userEmail']
        userData = request['allUsers']
        coursesEventsData = request['allCE']
        userProfiles = createUserProfiles(userData)
        recommendedCEIDs = recommendCEToUser(coursesEventsData, userProfiles, userEmail)
    RETURN JSON RESPONSE WITH recommendedCEIDs

FUNCTION createUserProfiles(userData)
    userProfiles = []
    FOR EACH user IN userData:
        userProfile = {
            'userID': user['email'],
            'userName': user['username'],
            'interests': user['interests'],
            'skills': user['skills'],
            'attendancePreference': user['attendancePreference'],
            'country': user['country'],
            'state': user['state'],
            'city': user['city']
        }
        userProfiles.append(userProfile)
    RETURN userProfiles

```

```
FUNCTION measureSimilarity(user1, user2)
```

```

user1Info = ' 'join(user1['skills'] + user1['interests'])

user2Info = ' 'join(user2['skills'] + user2['interests'])

vectorizer = TfidfVectorizer()

tfidfMatrix = vectorizer.fit_transform([user1Info, user2Info])

similarityScore = COSINE_SIMILARITY(tfidfMatrix[0], tfidfMatrix[1])[0][0]

RETURN similarityScore

FUNCTION recommendCEToUser(allCE, userProfiles, userID)

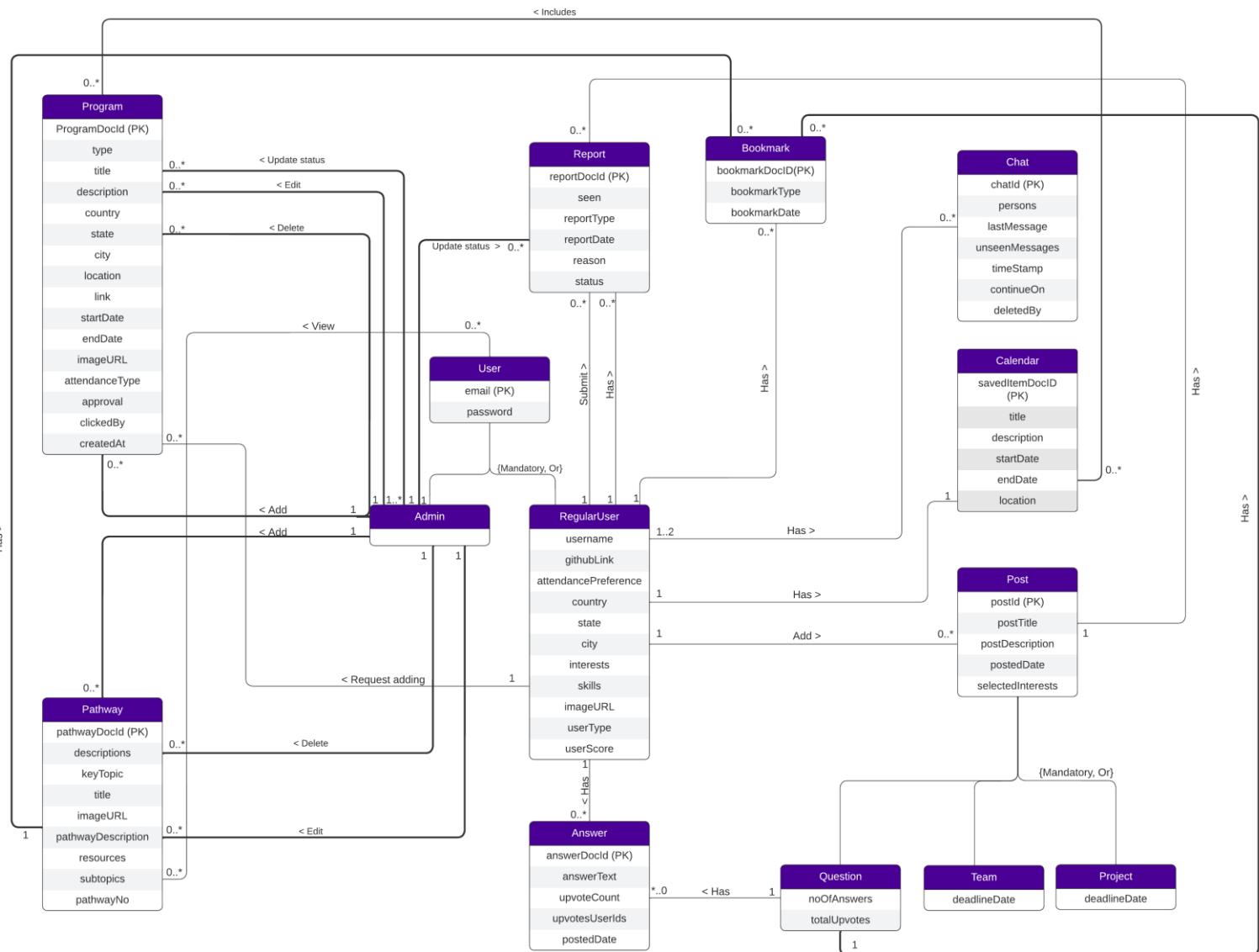
    specificUser = NULL

    FOR EACH user IN userProfiles:
        IF user['userID'] == userID THEN
            specificUser = user
            BREAK
        similarUsers = []
        FOR EACH user IN userProfiles:
            IF user != specificUser THEN
                similarityScore = measureSimilarity(specificUser, user)
                IF similarityScore >= 0.5 THEN
                    similarUsers.append((user, similarityScore))
        recommendedCE = []
        FOR EACH CE IN allCE:
            CEID= CE['CEID']
            CEAttendanceType = CE['attendanceType']
            CECountry = CE['country']
            CEState = CE['state']
            CECity = CE['city']
            similarityScore = 0
            FOR EACH similarUser IN similarUsers:
                IF similarUser['userID'] IN ce.get('clickedBy', []):
                    similarityScore += 0.2
                IF CEAttendanceType == specificUser.get('attendancePreference'):
                    similarityScore += 0.05
                IF CECountry != NULL THEN
                    IF CECountry.strip().lower() == specificUser.get('country').strip().lower():
                        similarityScore += 0.02
                IF CEState != NULL THEN
                    IF CEState.strip().lower() == specificUser.get('state').strip().lower():
                        similarityScore += 0.03
                IF CECity != NULL THEN
                    IF CECity.strip().lower() == specificUser.get('city').strip().lower():
                        similarityScore += 0.05
            recommendedCE.append((CEID, similarityScore))
        recommendedCE.SORT(key=lambda x: x[1], reverse=True)
    RETURN [CE[0] for CE in recommendedCE[:10]]
    
```

## 4.4 Data Design

#### 4.4.1 Data Models

- ER diagram



*Figure 11: ER Diagram*

The above ER diagram provides an insightful visualization of Texel's application entities and their interconnected operations. It adheres to ER naming conventions, capitalizing entity names as singular nouns, and ensuring attribute names are lowercase nouns. For instance, the "Program" entity represents both courses and events. Using the standardized UML (Unified Modeling Language) notation, this diagram portrays the relationships between entities.

Connections or relationships in this diagram are represented by lines between entities while clearly defining multiplicity.

It's important to note that foreign keys are intentionally omitted from the entities in adherence to UML notation standards.

To read this diagram, consider the following scenarios as examples:

1. A regular user may have zero to many chats, and each chat belongs to one user (if the user is chatting with themselves) or two users (if it's a conversation between two users).
2. A regular user can post none or multiple posts. Each post is associated with one user.
3. Furthermore, a post may have none or several reports, with each report distinctly linked to a singular post.

- **The non-relational data model.**

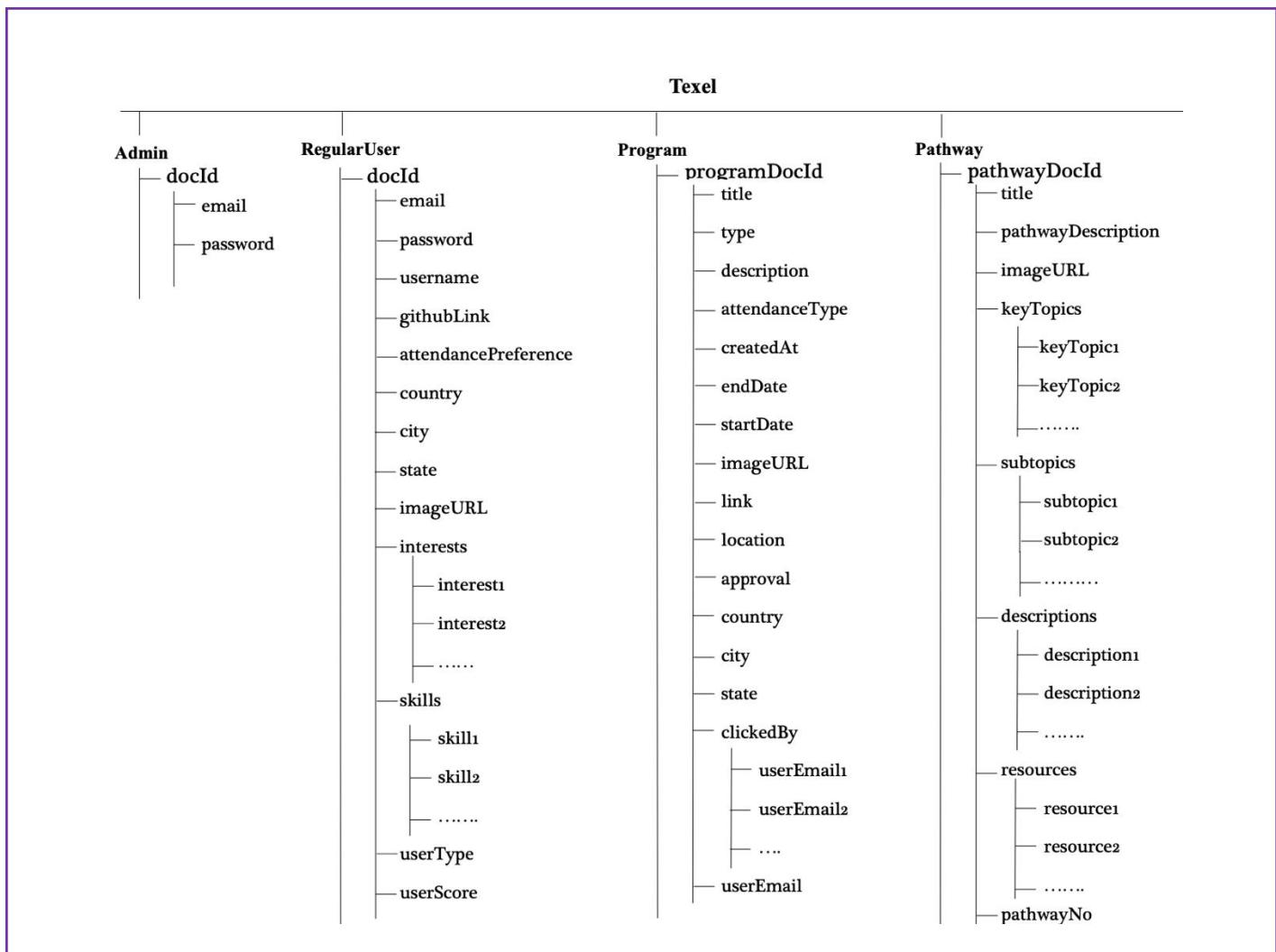


Figure 12.1: Non-relational Model Tree

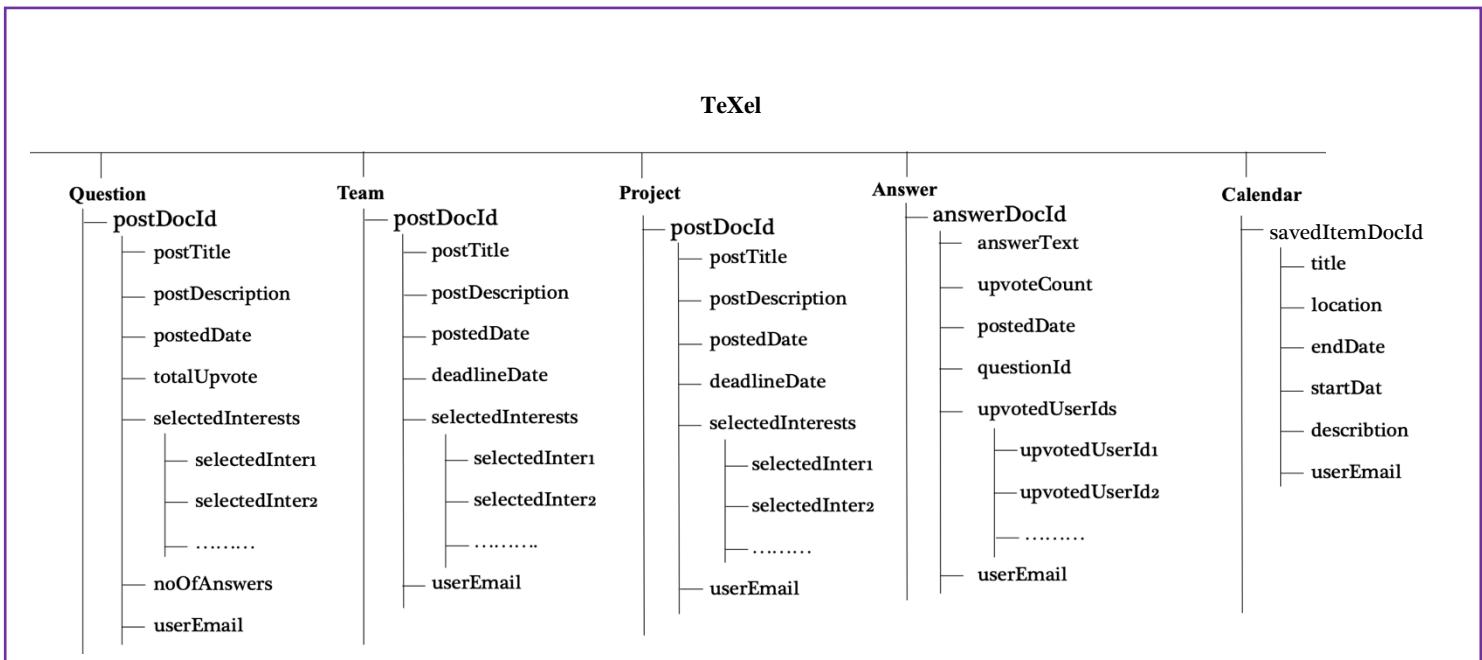


Figure 12.2: Non-relational Model Tree

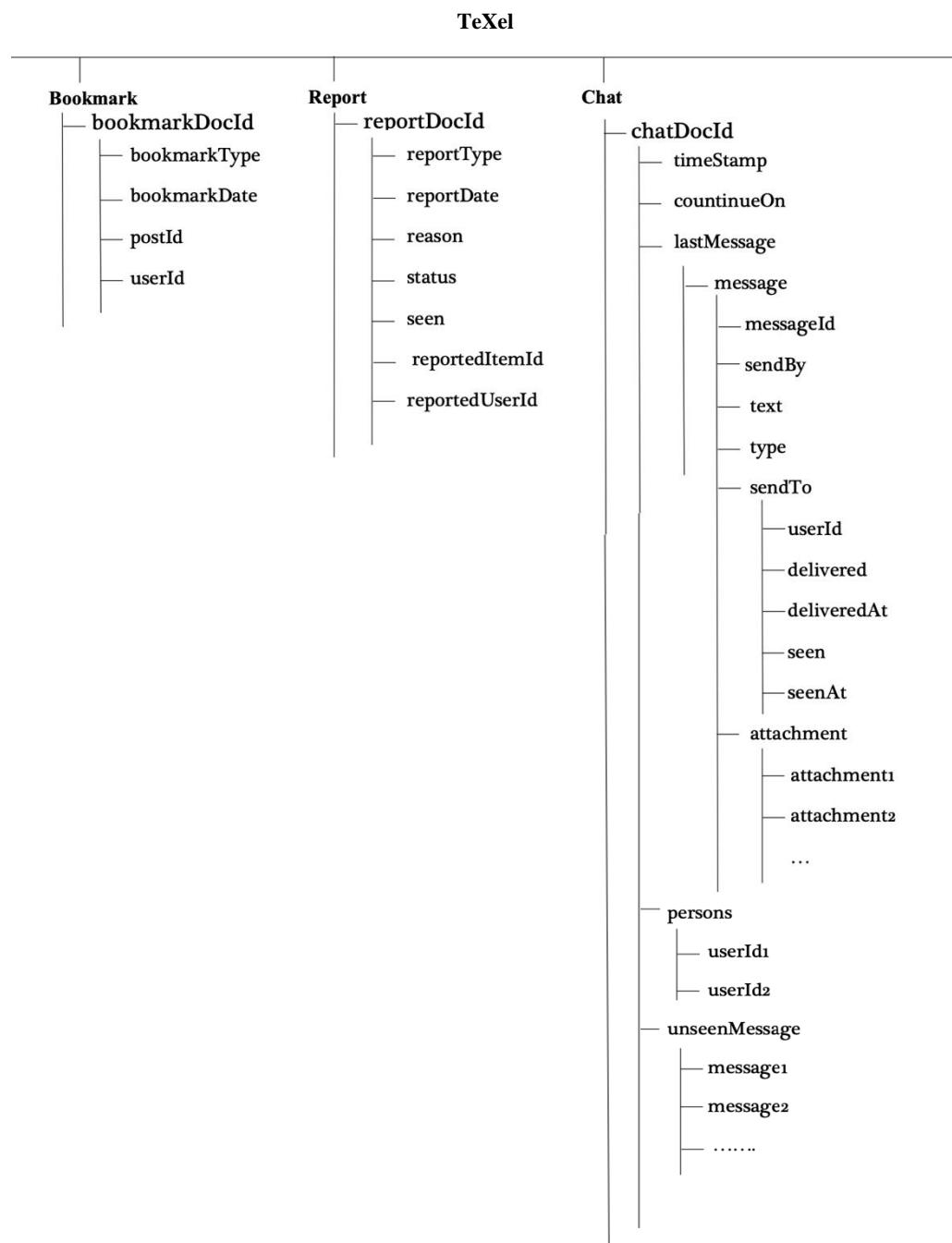


Figure 12.3: Non-relational Model Tree

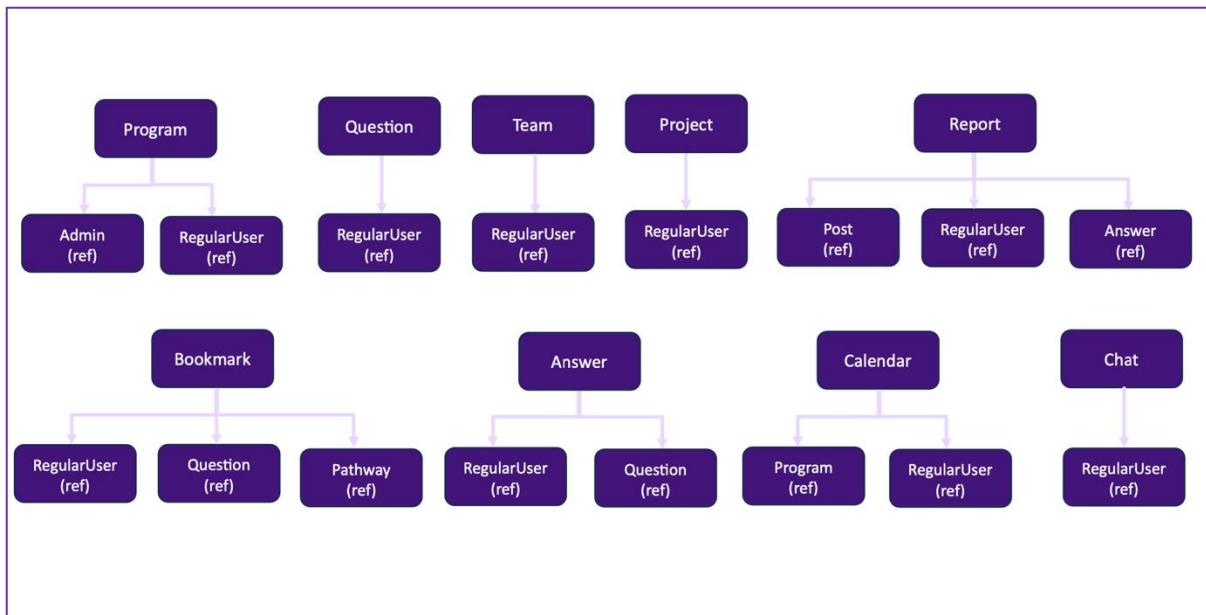


Figure 13: Non-relational Model- Relationships Approach

In the context of database design, it's important to model database in order to understand its design. Figure 12.1 ,12.2 and 12.3 illustrates a hierarchical tree structure of collections, documents, and attributes where the indentation represent a different level in the tree, while figure 13 demonstrates the relationships between these collections.

And for the relationship between collection, we have:

- The "userEmail" attribute in the "Program" collection is a reference from either the "RegularUser" collection or the "Admin" collection. This attribute indicates the email of the user who submits a program “course or event”.
- The "userEmail" attribute in the "Question" collection is a reference from the "RegularUser" collection, indicating the email of the user who submits a question.
- The "userEmail" attribute in the "Team" collection is a reference from the "RegularUser" collection, indicating the email of the user who submits a team collaboration request.
- The "userEmail" attribute in the "Project" collection is a reference from the "RegularUser" collection, indicating the email of the user who submits a project request.
- The "userEmail" attribute in the "Answer" collection is a reference from the "RegularUser" collection, indicating the email of the user who submits an answer.

- The "questionId" attribute in the "Answer" collection is a reference from the "Question" collection, indicating the question ID for which this answer is submitted.
- The "upvotedUserIds" attribute in the "Answer" collection is a reference from the "RegularUser" collection, indicating the email of the user who upvoted an answer.
- The "title" attribute in the "Calendar" collection is a reference from the "Program" collection, indicating the title of the program that is added to the user's calendar.
- The "location" attribute in the "Calendar" collection is a reference from the "Program" collection, indicating the location of the program that is added to the user's calendar.
- The "startDate" attribute in the "Calendar" collection is a reference from the "Program" collection, indicating the start date of the program that is added to the user's calendar.
- The "endDate" attribute in the "Calendar" collection is a reference from the "Program" collection, indicating the end date of the program that is added to the user's calendar.
- The "userEmail" attribute in the "Calendar" collection is a reference from the "RegularUser" collection, indicating the email of the user who adds the program to calendar.
- The "postId" attribute in the "Bookmark" collection is a reference from the "Pathway" or "Question" collection, indicating the post ID for which this post is bookmarked.
- The "userId" attribute in the "Bookmark" collection is a reference from the "RegularUser" collection, indicating the email of the user who adds the post or pathway to bookmarks.
- The "reportedItemId" attribute in the "Report" collection is a reference to an item from the super "Post" collection, which includes "Question", "Team", or "Project" collections, as well as a reference from the "Answer" collection, indicating the ID of the post or answer that was reported.
- The "reportedUserId" attribute in the "Report" collection is a reference to the "RegularUser" collection, indicating the user ID of the account that is reported.
- The "userId" and "sendBy" attributes in the "Chat" collection are references from the "RegularUser" collection, indicating the emails of the users who are involved in the chat.

#### 4.4.2 Data Collection and Preparation

In the data collection and preparation context, our system does not rely on external sources for data. Instead, we have integrated and retrieved part from our existing database from Firebase with the application and utilized it within the recommendation system. Additionally, at TeXel, we have two recommendation systems; the first one is Content-Based recommender system where the dataset contained in it includes the questions, the number of answer related to each question, the category of these questions, as well as the total number of upvotes and posted date for question, along with user skills and interests. And for the second recommender the Hybrid approach recommender system for courses and events , the dataset we use include

This integration enables the recommendation system to directly apply and reflect real-time results based on the data available in our database.

The recommendation system was implemented using Python. To access and utilize the data through Python, we needed to perform some data preprocessing procedures to adapt it for use within the recommendation system. These preprocessing procedures include:

- **Normalizing** the total upvotes and number of answers by dividing them by their respective maximum values.
- **Data handling** is done by removing time-zone information from the posted dates, converting them to Date-Time objects, and calculating the difference in days between the current date and the question timestamp.
- **Text Processing**, combining user skills and interests into a single string, and converting category lists of questions to strings.
- **TF-IDF** was used once the data preprocessing above was completed; we utilized cosine similarity. However, we needed to transform the factors into a compatible format to make this metric applicable. Hence, we employed TF-IDF to represent the factors in a way that aligns seamlessly with cosine similarity calculations.

Our system's robustness is underpinned by the comprehensive use of Python and its associated libraries and frameworks. We leveraged the capabilities of Pandas, NumPy, and Scikit-learn for data manipulation, and for the integration between database and Python code, we utilized Flask and Firebase admin. This comprehensive approach ensures the system is equipped to handle a wide range of data manipulation tasks.

## 4.5 Interface Design

UX design plays a vital role in software development as it directly impacts user engagement and retention. At the core of any software product, the user experience must be carefully crafted to keep users satisfied and willing to continue interacting with the platform.

Here at Texel, we recognize the importance of cultivating a positive community environment where users feel respected, heard, and motivated to remain active participants. Our goal is to design experiences that foster loyalty, so users enjoy engaging with one another and view our software as a place of value, learning and connection over the long term.

Ben Shneiderman's guidelines "Eight Golden Rules of Interface Design" have profoundly influenced user experience design at major technology companies like Google and Apple. At Texel, we implemented several of these foundational principles to improve our software's usability and foster positive user outcomes.[28]

- **UX Guidelines:**

**1- Strive for consistency:** use layout, colors, and icons that the user is accustomed to. E.g. using magnifier glass in Texel pages as search indicator.[28]

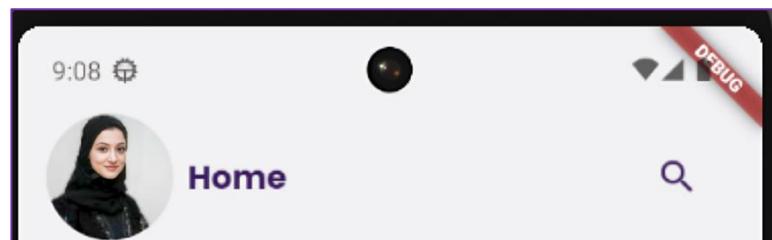


Figure 14: Magnifier Glass in TeXel Pages

**2- Offer informative feedback:** it's critical to provide users with feedback that they can comprehend. E.g. Texel sending clear message to ask if user is sure about deleting a post.[28]

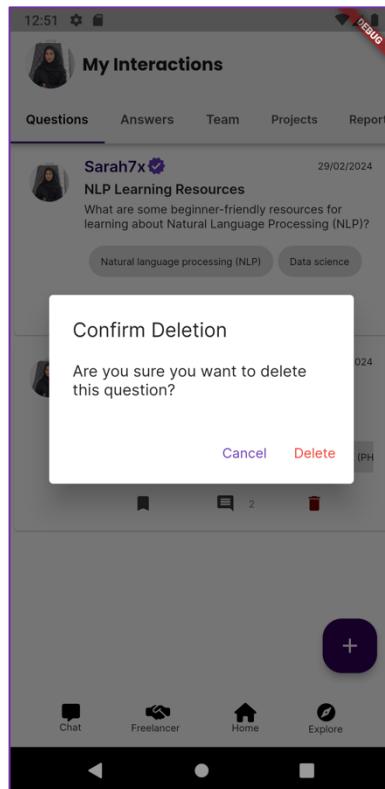


Figure 15: Delete Confirmation Message in TeXel

**3- Design dialogue to yield closure:** This will help the user stay informed about the status of the system and avoid confusion over what is happening. E.g. loading circle that appears when they click the login button.[28]

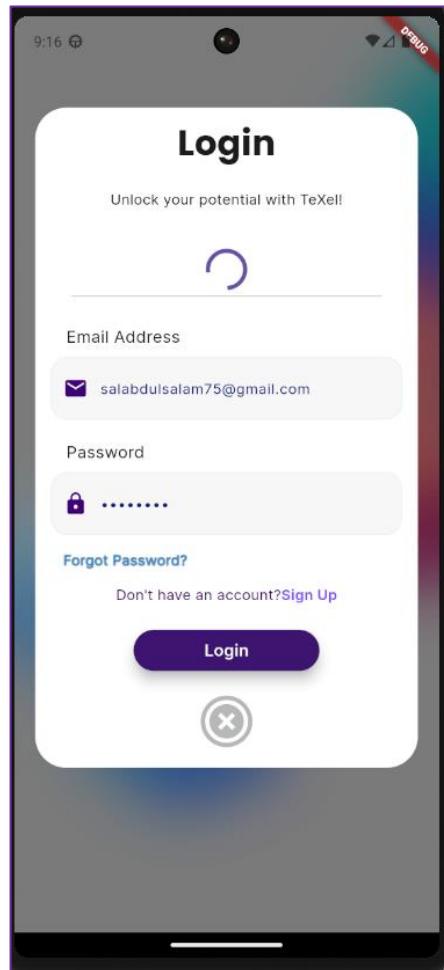


Figure 16: Loading in TeXel

**4- Permit easy reversal of actions:** As Schneiderman states in his book: “This feature relieves anxiety, since the user knows that errors can be undone; it thus encourages exploration of unfamiliar options.” E.g. Texel offering a cancel option when user presses on delete.[28]

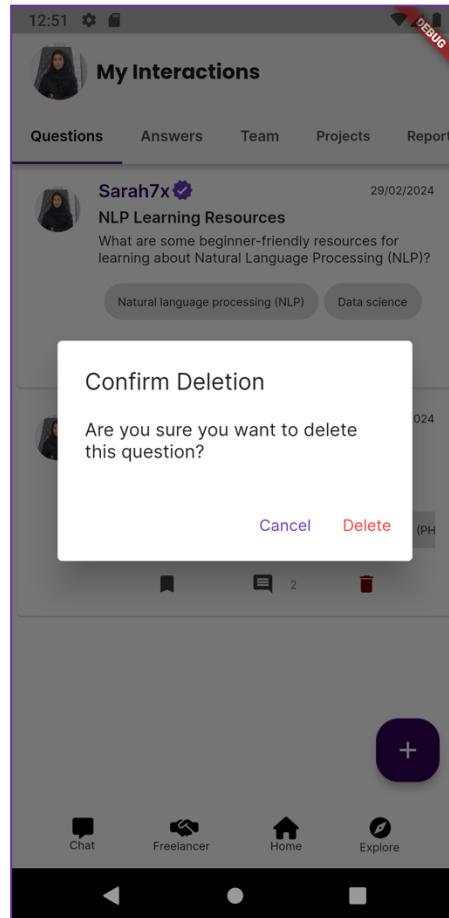


Figure 17: TeXel Cancel Option.

**5- Recognition rather than recall:** this refers to the idea that users shouldn't have to memorize information when navigating different software sections. E.g. Texel offers description on different type of posts and its always reachable.[29]

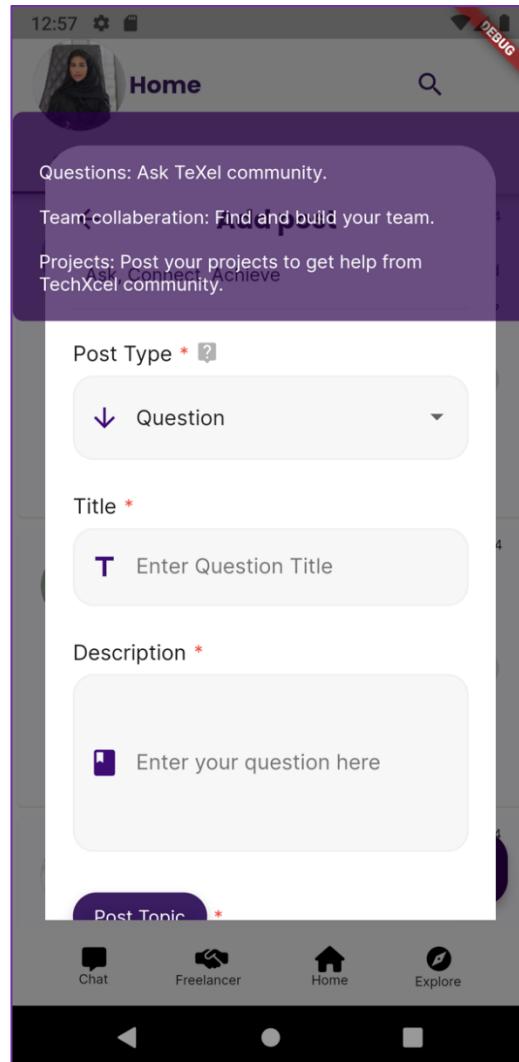


Figure 18: Post Description in TeXel.

**6-Aesthetic and minimalist design:** Dialogues shouldn't contain information that is rarely required. E.g. simple sentence indicates the success of the process after editing your account in Texel.[29]

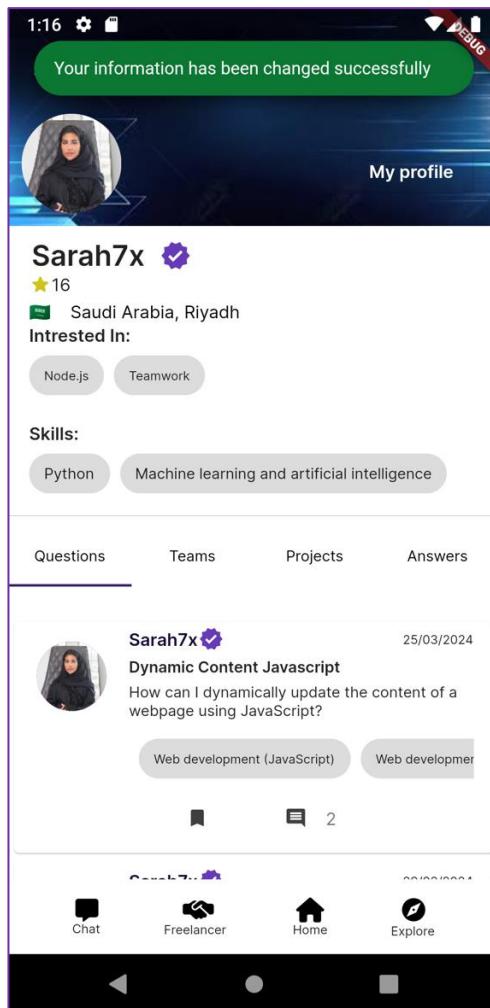


Figure 19: Successful Edit Account Message in Texel

- **sitemap:**

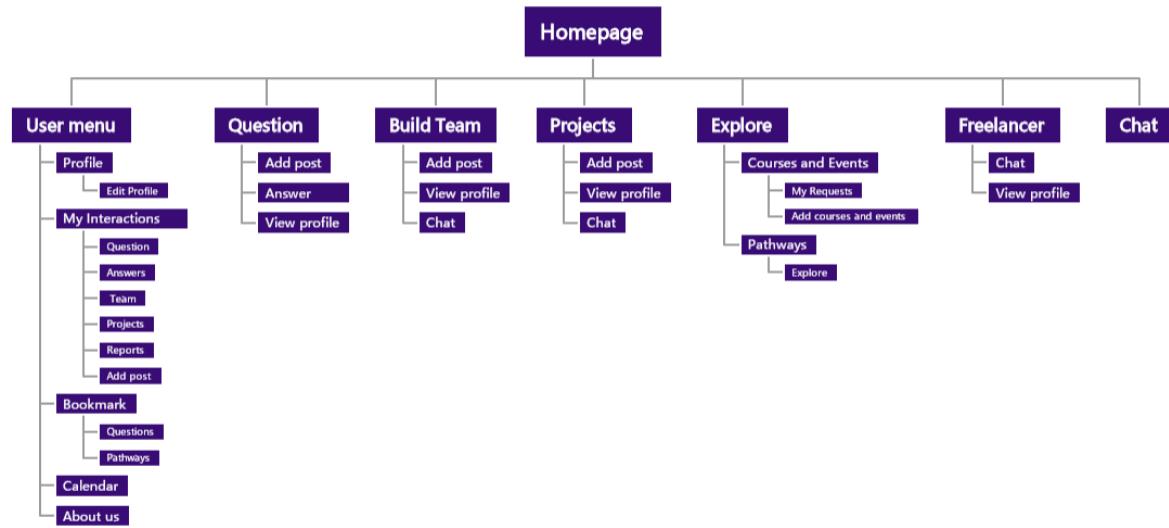


Figure 20: TeXel's Sitemap.

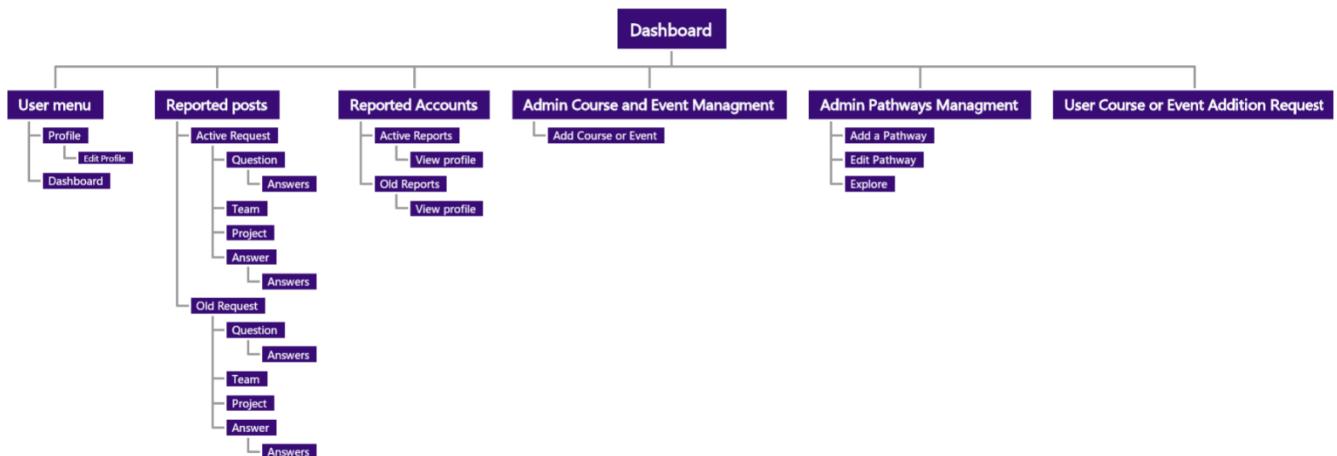


Figure 21: TeXel's Admin Sitemap.

## 4.6 Implementation

The "Texel" application was developed using the Visual Studio Code environment, utilizing the Flutter UI framework and the Dart programming language. Dart was chosen due to its extensive resources that assist in implementing the required functionalities effectively. An Android virtual device from Android Studio was utilized to test the application and ensure proper functionality. In the "Texel" application, Firebase was chosen as the platform of choice for its features and facilitation, which align well with agile development practices. Considering the rapid growth of our system's data, Firebase Firestorm was selected for its scalability. Integrating Firebase with our system involved:

1. Creating a project in Firebase.
2. Downloading the necessary files.
3. Placing them within the "Texel" project files.

- **Implementation challenges and difficulties**

During the development of Texel application, we faced numerous difficulties and challenges—one of the most significant hurdles involved implementing content-based and hybrid recommendation systems. Additionally, we encountered difficulties in effectively creating our unique API, deploying it on a global server, and integrating it with the Flutter app. This section will delve into the specific challenges we encountered during the implementation process.

### 1. Content-based Recommendation system

The primary challenge we encountered was determining the most appropriate algorithm for our homepage question recommender system, where recommended questions are prioritized at the top of the page. After conducting thorough research and analysis of recommendation systems, we came across numerous examples utilizing the TF-IDF algorithm, which closely matched the needs of our recommender. TF-IDF, or term frequency-inverse document frequency, is a statistical technique that evaluates the significance of a word within a document collection by considering both its frequency within a document and its rarity across the entire document set [30]. We chose to employ TF-IDF in our recommender to assess the similarity between various attributes such as "skills," "interests," and "questionTopics." The algorithm processes question-

related information, including IDs, replies counts, total upvotes, topics used in the question, and posting timestamps, in conjunction with registered users' skills and interests.

```

questions_data['questionTopics'] = questions_data['questionTopics'].apply(lambda x: ' '.join(x))

vectorizer = TfidfVectorizer()
tfidf_matrix = vectorizer.fit_transform(questions_data['questionTopics'])

user_combined = ' '.join(user_skills + user_interests)
user_tfidf_matrix = vectorizer.transform([user_combined])

similarity_scores = cosine_similarity(user_tfidf_matrix, tfidf_matrix).flatten()

```

*Figure 22: Questions Recommendation System Code Segment.*

It then correlates user skills and interests with question categories, assigning weights to each attribute and the corresponding match results.

```

weights = {
    'questionTopics': 0.5,
    'totalUpvotes': 0.1 ,
    'noOfAnswers': 0.2,
    'daysSincePosted': 0.4
}

```

*Figure 23: Weights for Additional Factors in Questions Recommendation System.*

## 2. Hybrid recommendation system

A hybrid recommendation approach is a technique that combines multiple recommendation algorithms or strategies to leverage the strengths of different methods and overcome the limitations of individual approaches. It typically integrates two recommendation systems: content-based filtering, and collaborative filtering, to provide more accurate and personalized recommendations to users. In the context of TeXel, specifically the courses and events page, with the recommended courses and events given priority placement first on the page. This approach is ideal for this page as it combines user interaction data and similarities between users.[31].

In the content-based component, we utilize the cosine similarity TF-IDF algorithm to identify similarities between users, as well as between users and items, specifically courses and events. This algorithm is particularly effective in measuring user similarity. To achieve this, we collect relevant user information, including their "interests" and "skills", which enables us to create a comprehensive user profile.

Furthermore, we measure the similarity between the user's preferences and the attributes of the courses and events. Specifically, we look at:

1. Location - We compare the user's location or preferred locations to the locations where the courses and events are held. This helps match users with courses and events that are geographically convenient for them.
2. User attendance preference - We analyze the user's preferred mode of attendance, such as onsite or online. We then match this preference with the type of attendance options available for each course and event.

By considering these course/event attributes in relation to the user's preferences, we are able to capture a detailed understanding of the user's requirements and match them with the most relevant courses and events. This helps provide personalized recommendations that are well-suited to the individual user's interests, skills, location, and scheduling needs.

```
# FUNCTION to measure similarity between two user profiles
def measure_similarity(user1, user2, user_info_list):
    # Combine interests and skills into a single string for each user
    user1_skills = user1.get('skills', [])
    user1_interests = user1.get('interests', [])
    user1_text = ' '.join(user1_skills + user1_interests)

    user2_skills = user2.get('skills', [])
    user2_interests = user2.get('interests', [])
    user2_text = ' '.join(user2_skills + user2_interests)

    # Convert user data to TF-IDF vectors
    vectorizer = TfidfVectorizer()
    tfidf_matrix = vectorizer.fit_transform([user1_text, user2_text])

    # Calculate cosine similarity between TF-IDF vectors
    similarity_score = cosine_similarity(tfidf_matrix[0], tfidf_matrix[1])[0][0]

    return similarity_score
```

Figure 24: Courses and Events Recommendation System Code Segment.

The collaborative filtering aspect of the system takes into account interactions among users with similar preferences. When a user likes a course, the system considers this course as a potential recommendation for other similar users. To facilitate this, the "clicked\_by" attribute is used to track user interactions, recording the users who have clicked on a particular course or event.

```
for similar_user, _ in similar_users:
    if similar_user['user_id'] in ce.get('clickedBy', []): # Using 'get' method to handle None
        similarity_score += 0.1
```

Figure 25: Attribute Used in Courses and Events Recommendation System to Track User Interactions

### 3. Deployment of recommendation systems python code

We encountered challenges while integrating the recommendation code into our Flutter application. After extensive research and reviewing similar applications, we utilized the Flask tool to develop our API, facilitating the connection between the recommendation system and our Flutter application. However, we encountered a limitation where the recommendations were only accessible locally on our devices. To overcome this constraint, we leveraged Heroku's cloud platform to deploy the recommendation system on a server, making it accessible globally. By doing so, we successfully connected the system to our Flutter app, eliminating the need to access the Python code locally on each machine, enabling seamless access to the recommendations from anywhere.

- **Resources and packages**

Given Dart's extensive resources and packages, we leveraged its capabilities to develop the "Texel" application. Specifically, we utilized several Dart packages, including a calendar, a list of countries, and animation. These packages provided valuable functionality and features that enhanced the application's overall user experience and system functionality.

- **Calendar**

We developed the calendar feature from the syncfusion\_flutter\_calendar package [20]. This package provides a comprehensive set of built-in view modes, including day, week, workweek, month, schedule, timeline day, timeline week, and timeline workweek. This flexibility enabled us to create a more comprehensive and customizable calendar experience within our application. We specifically required the package for our calendar feature, which allows users to save and manage their courses and events effectively. This package provided the functionality to create a user-friendly interface where users could seamlessly organize their schedules and keep track of important dates and appointments.

Incorporating this package enhanced the overall user experience and delivered a robust calendar.

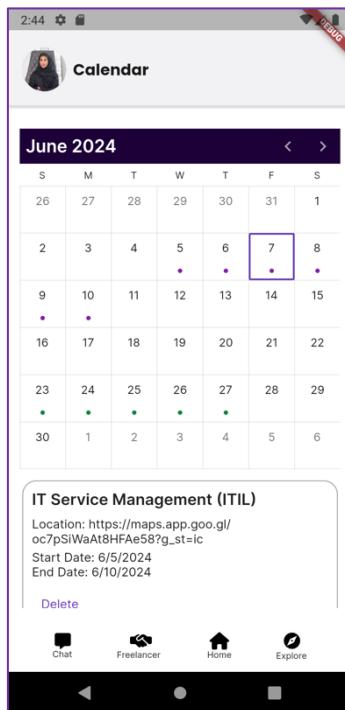


Figure 26: Calendar in TeXel [20]

- **List of countries**

We continued our work with Dart packages and successfully integrated the csc\_picker package into our project [19]. This package, with its unique ability to display countries, states, and cities within the application, proved to be a game-changer. It empowered us to offer users the convenience of selecting their country, state, and city from a comprehensive list, thereby enhancing their experience.

This package proved highly beneficial, allowing us to display countries, states, and cities within the application. With the package, we could offer users the convenience of selecting their country, state, and city from a comprehensive list

The package dynamically updated the available options based on the user's selections, enabling a streamlined and efficient user experience. Additionally, the package allowed for easy searching of countries, states, and cities worldwide, ensuring that users could find and select their location accurately. We primarily utilized this package during the signup process to facilitate users in entering their country information quickly and accurately. By integrating the (csc\_picker) package, we aimed to enhance the user-friendliness and efficiency of the signup.

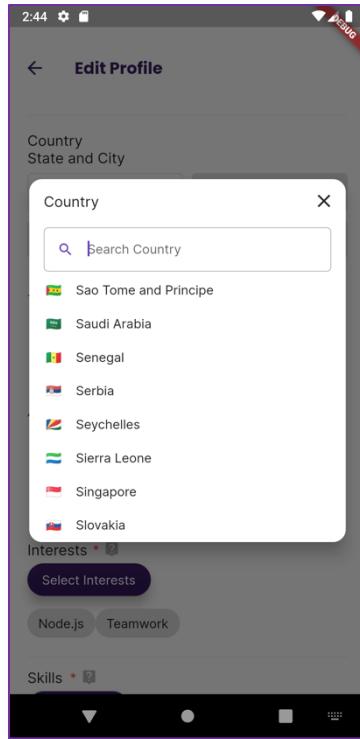


Figure 27: List of Countries in TeXel[19]

- **Animation**

Additionally, we incorporated the (RiveAnimation) [32] package into our project, which proved valuable in enhancing the user experience. (RiveAnimation) is a real-time interactive design and animation tool that seamlessly integrates animations into Flutter applications.

Utilizing the RiveAnimation widget, we could import our Rive (formerly known as Flare) assets into FlutterFlow and effortlessly integrate them into our application. This package enabled us to bring our designs to life with captivating animations, adding an extra layer of interactivity and visual appeal to the user interface. The integration of (RiveAnimation) allowed us to create engaging and dynamic elements within the app, enhancing the overall user experience and making the application more visually appealing and interactive. The ability to leverage Rive assets seamlessly within our Flutter application was instrumental in achieving our goal of providing an enjoyable and immersive user experience.



*Figure 28: Rive Animation [25]*

- **HTTP package:**

The http package in Dart is a widely-used library that provides a simple and convenient way to make HTTP requests from Dart applications. It allows developers to interact with web services and APIs by offering a set of methods to perform various types of HTTP requests, such as `get()`, `post()`, `put()`, `delete()`, and `patch()`. The package handles the underlying complexities of making the HTTP requests and parsing the responses, making it easier for developers to focus on the application logic.

Within TeXel application, the http package is utilized in the `recommendQuestions()` and `recommendCEs()` functions to communicate with a Flask-based API deployed on Heroku. Specifically, the `http.post()` method is used to send a POST request to the API, with the request body containing the necessary information to recommend questions/courses and events. The package is responsible for constructing the request, including the headers and the request body, and then handling the response from the API. If the response is successful (status code 200), the function extracts the recommended question IDs from the response body and updates the application state accordingly. [33]

```

    Future<void> recommendQuestions(
        List<Map<String, dynamic>> questionsJson) async {
        final Map<String, dynamic> requestBody = {
            'user_skills': userSkills,
            'user_interests': userInterests,
            'all_questions': questionsJson,
        };

        final response = await http.post(
            Uri.parse('https://flask-deploy-gp2-717dff55916.herokuapp.com/'),
            headers: <String, String>{
                'Content-Type': 'application/json; charset=UTF-8',
            },
            body: jsonEncode(requestBody),
        );
    }
}

```

Figure 29: Code Segment Using HTTP Package [33]

- **Crypto Package:**

The crypto package is a widely used Dart library that provides a comprehensive set of cryptographic functions and algorithms. This includes common hashing algorithms like SHA-256, which are essential for securely handling sensitive user data in applications.

Within the context of the TeXel app, the crypto package is used to securely handle sensitive user data, such as passwords. Specifically, the hashPassword() function in the code snippet is using the sha256.convert() method from the crypto package to generate a SHA-256 hash of the user's password before it is stored in database or transmitted.

The use of the crypto package in the TeXel app aligns with industry-standard security best practices. By incorporating secure hashing techniques, the app can enhance the protection of user credentials and minimize the risk of unauthorized access or data breaches. This is particularly important for applications that handle sensitive user information, such as login credentials.[34]

```

String hashPassword(String password) {
    var bytes = utf8.encode(password); // Encode the password as bytes
    var digest = sha256.convert(bytes); // Hash the bytes using SHA-256
    return digest.toString(); // Convert the hash to a string
}

```

Figure 30: Hashing Password Using Crypto Package [34]

- The GitHub link:

<https://github.com/lina-tamim/2023-GP1-17.git>

## 5 System Evaluation

### 5.1 User Acceptance Testing

#### 5.1.1 Demographics of Participants

The participants in the application testing were asked about their age, gender, education level, and experience with mobile applications. The following figure () displays their answers.

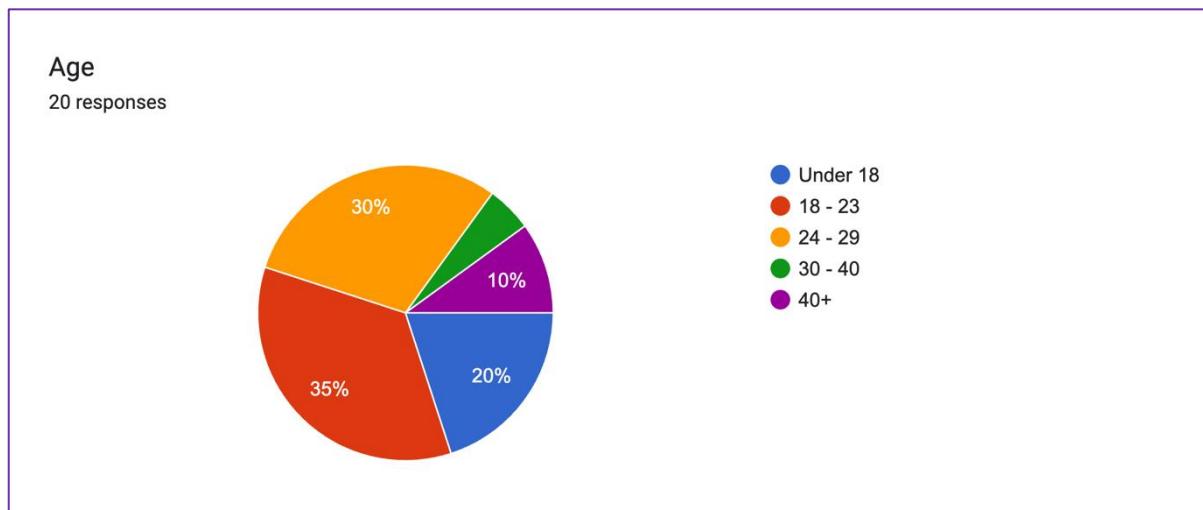


Figure 31: Participants Age Distribution.

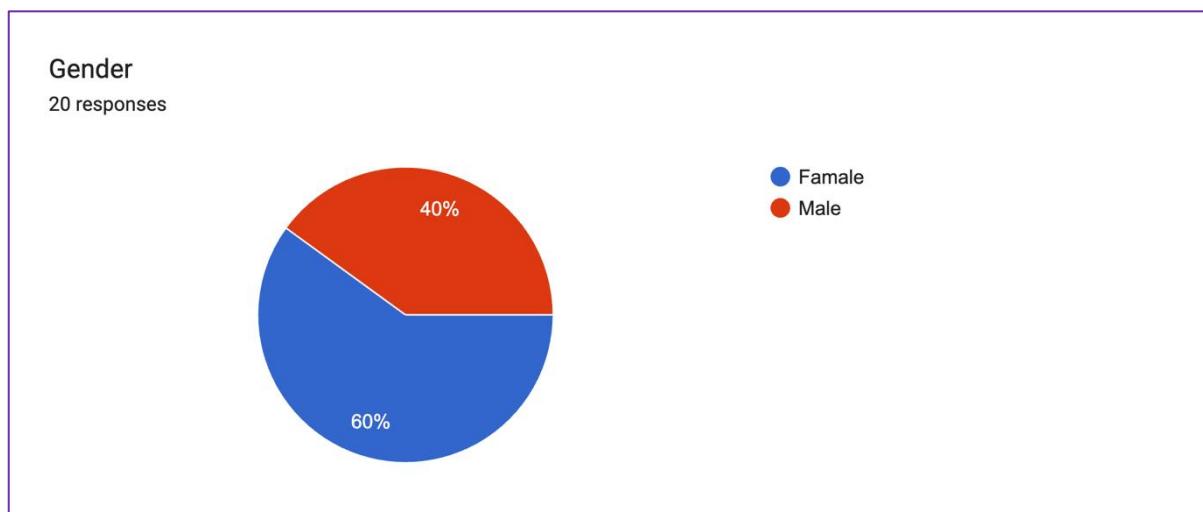


Figure 32: Participants Gender Distribution.

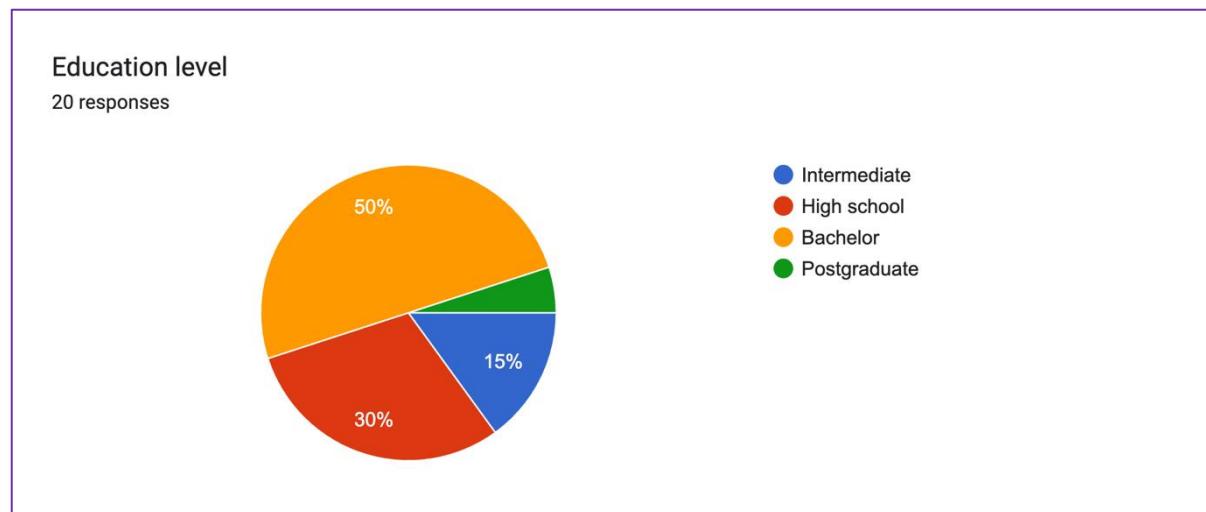


Figure 33: Participants Educational Levels Distribution.

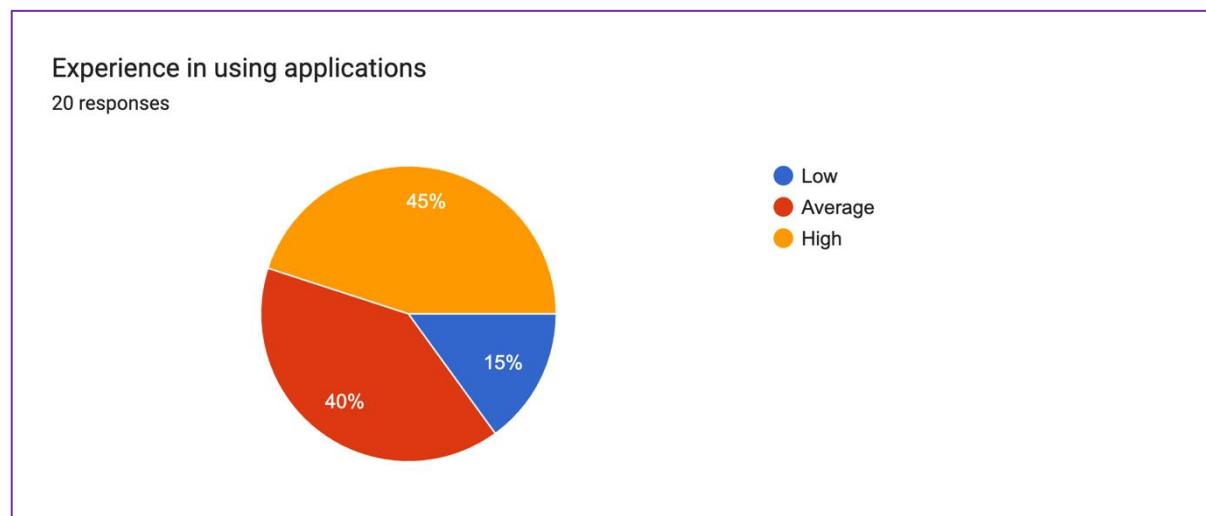


Figure 34: Participants Technical Experience Levels Distribution.

### 5.1.2 Questionnaire/Interview Results

The 20 participants in the application testing were asked about their experience with our application. The results of the questionnaire are summarized in Table 3.[35]

Question	Number of respondents (Percentage of responses)			
	Strongly agree	Agree	Disagree	Strongly disagree
I needed previous experience to use the app.		2 (10%)	8 (40%)	10 (50%)
I found the app easy to use. I found the app to be properly threaded and navigating between pages was easy.	13 (65%)	7 (35%)		
I found the colors comfortable.	14 (70%)	6 (30%)		
I found the application interface design clear and easy to use.	13 (65%)	7 (35%)		
I found that some of the icons did not have a clear meaning.	12 (60%)	4 (20%)	3 (15%)	
I found the app to have a fast response.	13 (65%)	7 (35%)		
I think I will use the app frequently.	14 (70%)	6 (30%)		
I was able to post a question, team collaboration, project correctly, easily, and clearly.	10 (50%)	10 (50%)		
I was able to search for a post correctly, easily, and clearly.	13 (65%)	7 (35%)		
When I viewed the home page, the recommended questions were useful to me.	11 (55%)	9 (45%)		
I was able to chat with other users through private messages correctly, easily, and clearly.	11 (55%)	9 (45%)		
I was able to post course/event correctly, easily, and clearly.	12 (60%)	8 (40%)		
When I viewed the explore page, the recommended courses and events were useful to me.	9 (45%)	9 (45%)	2 (10%)	
I was able to explore pathways correctly, easily, and clearly.	12 (60%)	8 (40%)		
I was able to view all freelancers in one page correctly, easily, and clearly.	12 (60%)	8 (40%)		
I was able to add specific question to bookmark correctly, easily, and clearly.	10 (50%)	10 (50%)		
I was able to add specific course/event to my calendar correctly, easily, and clearly.	12 (60%)	8 (40%)		
I was able to view my interactions correctly, easily, and clearly.	9 (45%)	8 (40%)	3 (15%)	

I was able edit my profile correctly, easily, and clearly.	13 (65%)	7 (35%)		
The pop-up messages I get from the app were helpful and clear.	13 (65%)	7 (35%)		
I will recommend this app to my friends and family.	13 (65%)	7 (35%)		
We will be pleased with your suggestions and comments:				
I felt like the app was similar to social media platforms like twitter and that's a good thing! i just wish we had more control over choosing account header and bio				
I wish it supports Arabic language				
I wish if I could edit my posts				
great application and great idea				
everything is perfect				
add more recommendations to the app				

*Table 3: Participants Responses.*

## 5.2 Quality Attributes (NFR testing)

User story	Quality attribute	Measure	Results
As a user, I want the platform to be simple and clear where my training time to use it does not require more than 1 hour, so that I can quickly navigate the platform and start utilizing its features effectively.	Usability: how the application is easy to learn and user-friendly. [36]	The System Usability Scale (SUS) was used which is a reliable and quick tool that measures the usability of a system [37]. SUS consists of 10 questions (see appendix for the questions) and the overall usability is calculated by finding the mean score for the responses of the participants.	We tested our application with five users, and the average score was 88, which is higher than the average system usability scale (SUS) score of 68, indicating that our application is highly usable.
As a user, I want the app to handle errors efficiently and provide clear and error messages, so that I can understand what went wrong and take appropriate action.	Reliability: How well the software can perform in a particular environment for a specified period of time without failure.[38]	Various of error was made by testers to see how the system reacts.	TeXel was built using flutter framework which catches errors that occur during the run.[39]
As a user, I want my password to be stored securely using encryption techniques, so that my password remains protected.	Security: How authorized access to protected data is granted and unauthorized access is restricted in the application.[40]	Only authenticated users are allowed to access the software.	TeXel depends on firebase authentication for authentication, and we found that Firebase Authentication uses an internally modified version of script to hash account passwords.[41]
As an admin, I want to have higher permissions than regular users, so that regular users are	Security: How authorized access to protected data is granted and unauthorized access is restricted in the	Only authenticated admins can login to admin side application.	TeXel uses Firebase Authentication for user login, which is restricted to each authenticated user.[41]

restricted from accessing sensitive functions.	application.[40]		
As a user, I want the application to be available 99% of the times I try to access it, so that I can access the application at any time I need it.	Availability: how likely it is that a user will be able to access the system.[42]	Compute the percentage of application availability.	TeXel depends on Firebase for authentication and storage data, and this is what effects on availability. According to the Firebase website [43], we found that Firebase's availability is at least 99.95% of the time, which means our application's availability is greater than 99%.

Table 4: Nonfunctional Requirements in TeXel.

### 5.3 Discussion

Based on the results of testing 20 participants in the User Acceptance Testing (UAT), the majority of participants had positive experiences with the application. The questionnaire responses indicated that users found the app easy to use, with a clear interface design and comfortable colors. They also reported being able to navigate between pages easily and found the app to have a fast response. These positive results suggest that the design and development efforts were successful in creating a user-friendly and efficient application.

In terms of Non-Functional Requirements (NFR), the application demonstrated high usability, as measured by the System Usability Scale (SUS) score of 88, which is above the average SUS score of 68. This indicates that the application is highly usable and meets the usability requirements set for it. Additionally, the availability of the application was found to be greater than 99%, exceeding the requirement of 99% availability.

Overall, the results obtained from the system evaluation were good, indicating that the design and implementation of the application were effective. However, there is always room for improvement. Here are some areas to consider for further enhancement:

- **User Feedback:** While the UAT results were largely positive, it is essential to gather feedback from users to identify any potential areas for improvement. Conducting user surveys, interviews, or focus groups can provide valuable insights and help identify specific features or functionalities that can be further refined.
- **Error Handling:** Although the app was found to handle errors efficiently, continuous monitoring and testing should be conducted to identify and address any unforeseen errors or exceptions that may arise during real-world usage. Regular updates and bug fixes can help improve the overall reliability of the application.
- **Localization and Customization:** Considering the suggestion for Arabic language support and the desire for more control over account headers and bios, incorporating localization options and allowing users to customize their profiles can enhance the user experience and cater to a broader audience.

- Performance Optimization: While the app demonstrated fast response times, ongoing performance optimization can further improve the application's speed and responsiveness. Regular performance testing and optimization techniques can help identify and address any bottlenecks or areas of improvement.

In summary, while the system evaluation yielded positive results, there is always room for improvement in the process, design, and implementation. By gathering user feedback, addressing error handling, enhancing localization and customization options, and optimizing performance, the application can continue to evolve and provide an even better user experience.

## 6 Conclusions and Future Work

This document chronicles our journey with Texel, beginning with the introduction chapter. This chapter provides an overview of the problem we aimed to solve and introduces the solution we developed. It serves as a general introduction to Texel, setting the stage for the subsequent chapters. Following the introduction, we delve into the background chapter, which plays a crucial role in helping readers grasp the intricacies of the Texel application. This section concisely explains the knowledge aspects involved, such as recommender systems and their several types. By providing this contextual information, we aim to give readers a deeper understanding of Texel. Moving forward, the literature review chapter focuses on a comprehensive examination and discussion of mobile applications in the same field as Texel. This review serves multiple purposes: identifying any existing gaps in the market that Texel can fill and specifying the unique features that set Texel apart from its competitors. By conducting this review, we ensure that Texel offers distinct and valuable features to its users. We proceed to the system design chapter with a clear vision of Texel's features. This phase involves translating Texel's features into a framework that promotes an understanding of its components and their interplay. This phase lays the groundwork for the subsequent development stage. Following the system design phase, we developed the Texel application, utilizing the Flutter framework and Dart programming language. Throughout the system Evaluation section, we assess Texel's performance. User Acceptance Testing is conducted to gauge user satisfaction and identify any areas for improvement. The participants' demographics are analyzed to understand the user base better and get feedback based on the Questionnaire and interview results. Finally, the Discussion section offers insights and reflections on the evaluation findings, guiding future enhancements and iterations of the Texel application.

### • Global and Local Impact

Texel, a platform developed in Saudi Arabia, significantly impacts local and global. At a global level, Texel enables users worldwide to ask and answer technical questions, fostering an international community of knowledge sharing and collaboration. It also facilitates connections with freelancers, allowing for remote work opportunities and global expertise to be leveraged. Moreover, Texel provides access to pathways, allowing users from various locations to explore learning paths tailored to their interests. On a local scale, Texel empowers users within the Saudi Arabian community to build teams, fostering local collaborations and networking opportunities. It serves as a platform for businesses and individuals to find freelancers for their

projects, promoting local and global talent and supporting the growth of the local economy. Additionally, Texel shares local courses and events, providing valuable resources for individuals seeking to enhance their skills and stay updated with local tech advancements and opportunities.

In summary, Texel's impact spans both local and global spheres. It facilitates international knowledge exchange, collaboration with freelancers, and access to pathways while supporting local team building, talent development, and engagement with local courses and events. This dual impact positions Texel as a valuable platform for the global tech community while maintaining a strong foundation within the local Saudi Arabian ecosystem.

#### • Problems and Challenges Encountered During the Software Development

During the project's development, we faced a significant challenge involving rapidly learning a new programming language and its associated tools. This time constraint imposed upon us the task of swiftly acquiring and assimilating further information within a limited timeframe. Moreover, we encountered technical issues that required troubleshooting and resolution, such as creating the database, establishing its connection with the Flutter project, recommendation system integration with Flutter, and addressing other coding-related obstacles. These collective challenges necessitated our ability to be agile in acquiring new knowledge and effectively overcoming technical hurdles.

#### • Limitations of the System

Focusing on the limitations, Texel is an Android mobile application designed to provide users with a comprehensive technology experience. It offers a range of features and functionalities that cater to different aspects of the tech industry. However, it is essential to note that the application is currently only available for Android mobile devices. Additionally, the application supports the English language. While Texel covers a wide range of technology topics, it primarily focuses on events and courses in Saudi Arabia. However, online courses and events are also available, providing broader accessibility to users worldwide. It's worth mentioning that Texel does not include payment-related features. Therefore, user transactions, such as hiring freelancers, must be handled separately outside the application. Furthermore, the application must facilitate the course and event registration process. Instead, users are provided links to external sources for further exploration and registration. Despite that, Texel is an improving software that will handle these limitations in future versions.

- **The Main Contribution of the Project**

The main contribution of the Texel project lies in its ability to consolidate features from various technology applications into a single platform while incorporating unique functionalities. By integrating these diverse features, Texel offers users a centralized hub for all their technology-related needs. Moreover, the application leverages AI technology to provide personalized recommendations, setting it apart from similar platforms. This personalized approach enhances the user experience by offering tailored content and opportunities that align with individual interests and goals. By combining a wide range of features and utilizing AI technology, Texel strives to optimize user engagement, knowledge acquisition, and collaboration within the technology community.

- **Future work**

Texel aims to enhance the user experience in its upcoming journey by introducing several new features. Texel plans to expand the language support to include multiple languages and compatibility with different operating systems to enhance accessibility for a broader user base. Besides introducing payment functionality, it enables seamless freelancer transactions and facilitates exploring worldwide courses and events. In addition to the application, Texel plans to launch a website similar to the application to allow access for all users. Texel's upcoming additions show commitment to improving the platform and meeting the changing needs of users.

## 7 Acknowledgements

First and foremost, we want to pour our sincerest gratitude to every single individual who has poured their time, effort, and unwavering love into making this project an astounding success.

To our esteemed supervisor, Dr. Mashael Alsaleh, your unwavering guidance and steadfast support have been the beacon that illuminated our path through the darkest of challenges. Your unwavering belief in us has fueled our spirits and driven us to reach new heights of excellence.

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And to the dedicated testers who generously lent us their precious time and invaluable feedback during the user acceptance testing, your contributions have touched us profoundly. Your insights and constructive criticism have been the catalysts that have driven us to strive for perfection, ensuring that this project truly resonates with the needs and aspirations of the end-users.

Moreover, we are deeply grateful to King Saud University, which has served as the incubator for our knowledge and growth. The lessons we have learned within its esteemed halls have been instrumental in shaping our approach and guiding us towards this remarkable achievement. We are proud to have employed the expertise and insights gained from our time at this renowned institution in the realization of this project.

This journey has been filled with countless challenges, but it has also been a testament to the power of human connection, collaboration, and growth. Each and every one of you has played a pivotal role in shaping this endeavor, and for that, we are eternally grateful.

From the deepest recesses of our hearts, we express our heartfelt thanks. This achievement is as much yours as it is ours, and we are honored to have had the privilege of working alongside such an extraordinary team of individuals.

## 8 References

- [1] Gibson, D. (2022, June 22). Asked and answered: the results for the 2022 Developer survey are here! Stack Overflow Blog. <https://stackoverflow.blog/2022/06/22/asked-and-answered-the-results-for-the-2022-developer-survey-are-here/>
- [2] Webb, G.I. and Sammut, C. (2010) Encyclopedia of Machine Learning, SpringerLink. Available at: <https://link.springer.com/referencework/10.1007/978-0-387-30164-8> (Accessed: 18 September 2023)
- [3] Melville, P. and Sindhwani, V. (1970) Recommender Systems, SpringerLink. Available at: [https://link.springer.com/referenceworkentry/10.1007/978-0-387-30164-8\\_705](https://link.springer.com/referenceworkentry/10.1007/978-0-387-30164-8_705) (Accessed: 13 September 2023).
- [4] Schafer, B.J., Konstan, J. and Riedl, J. (1999) Recommender systems in e-commerce - ACM Digital Library, [https://dl.acm.org.](https://dl.acm.org/) Available at: <https://dl.acm.org/doi/pdf/10.1145/336992.337035> (Accessed: 16 September 2023).
- [5] Aggarwal, C.C. (2016) Recommender systems: The textbook - charu aggarwal, [https://link.springer.com/chapter/10.1007/978-3-319-29659-3\\_1](https://link.springer.com/chapter/10.1007/978-3-319-29659-3_1). Available at: <http://www.charuagarwal.net/Recommender-Systems.pdf> (Accessed: 16 September 2023).
- [6] Rocca, B. (2019) Introduction to recommender systems, Medium. Available at: <https://towardsdatascience.com/introduction-to-recommender-systems-6c66cf15ada> (Accessed: 12 September 2023).
- [7] Abdul Hameed, M., Al Jadaan, O. and Sirandas , R. (2012) Collaborative filtering based recommendation system: A survey, researchgate.net. Available at: [https://www.researchgate.net/profile/RamachandramSirandas/publication/267261428\\_Collaborative\\_Filtering\\_Based\\_Recommendation\\_System\\_A\\_survey/links/549ac4af0cf2fedbc30e3254/Collaborative-Filtering-Based-Recommendation-System-Asurvey.pdf](https://www.researchgate.net/profile/RamachandramSirandas/publication/267261428_Collaborative_Filtering_Based_Recommendation_System_A_survey/links/549ac4af0cf2fedbc30e3254/Collaborative-Filtering-Based-Recommendation-System-Asurvey.pdf) (Accessed: 11 September 2023).
- [8] Sarwar, B. et al. (2001) Item-based collaborative filtering recommendation algorithms - ETH Z, dl.acm.org. Available at: <https://www.ra.ethz.ch/cdstore/www10/papers/pdf/p519.pdf> (Accessed: 16 September 2023).
- [9] Mooney, R.J. and Roy, L. (2001) Content-based book recommending using learning ... - ACM Digital Library, ACM Digital Library. Available at: <https://dl.acm.org/doi/10.1145/336597.336662> (Accessed: 11 September 2023).

- [10] Thorat, P.B., Goudar, R.M. and Barve, S. (2017) A survey: Collaborative filtering, content-based filtering, hybrid recommendation approach, Academia.edu. Available at: [https://www.academia.edu/33736188/A\\_Survey\\_Collaborative\\_Filtering\\_Content\\_based\\_Filtering\\_Hybrid\\_Recommendation\\_Approach](https://www.academia.edu/33736188/A_Survey_Collaborative_Filtering_Content_based_Filtering_Hybrid_Recommendation_Approach) (Accessed: 16 September 2023).
- [11] Mohamed, M.H., Khafagy, M. and Ibrahim, M.H. (2019) Recommender Systems Challenges and solutions survey - researchgate, researchgate.net. Available at: [https://www.researchgate.net/profile/MarwaMohamed54/publication/331063850\\_Recommender\\_Systems\\_Challenges\\_and\\_Solutions\\_Survey/links/5c72d5bd\\_a6fdcc471598fce2/Recommender-Systems-Challenges-and-Solutions-Survey.pdf](https://www.researchgate.net/profile/MarwaMohamed54/publication/331063850_Recommender_Systems_Challenges_and_Solutions_Survey/links/5c72d5bd_a6fdcc471598fce2/Recommender-Systems-Challenges-and-Solutions-Survey.pdf) (Accessed: 11 September 2023).
- [12] Almahmood, R. J. K., & Tekerek, A. (2022). Issues and solutions in deep learning-enabled recommendation systems within the E-commerce field. *Applied Sciences* (Basel, Switzerland), 12(21), 11256. <https://doi.org/10.3390/app122111256>.
- [13] Ariwala, P. (2023) How do recommendation engines work? what are the benefits?, Maruti Techlabs. Available at: <https://marutitech.com/recommendation-engine-benefits/> (Accessed: 17 September 2023).
- [14] Firebase\_core: Flutter Package (2024) Dart packages. Available at: [https://pub.dev/packages/firebase\\_core](https://pub.dev/packages/firebase_core) (Accessed: 14 May 2024).
- [15] Firebase\_auth: Flutter Package (2024) Dart packages. Available at: [https://pub.dev/packages/firebase\\_auth](https://pub.dev/packages/firebase_auth) (Accessed: 14 May 2024).
- [16] Firebase\_storage: Flutter Package (2024) Dart packages. Available at: [https://pub.dev/packages/firebase\\_storage](https://pub.dev/packages/firebase_storage) (Accessed: 14 May 2024).
- [17] Firebase\_messaging: Flutter Package (2024) Dart packages. Available at: [https://pub.dev/packages/firebase\\_messaging](https://pub.dev/packages/firebase_messaging) (Accessed: 14 May 2024).
- [18] Ai search that understands (no date) Algolia. Available at: <https://www.algolia.com/> (Accessed: 14 May 2024).
- [19] Csc\_picker. (n.d.). Dart Packages. Retrieved November 21, 2023, from [https://pub.dev/packages/csc\\_picker](https://pub.dev/packages/csc_picker)
- [20] Syncfusion\_flutter\_calendar. (n.d.). Dart Packages. Retrieved November 21, 2023, from [https://pub.dev/packages/syncfusion\\_flutter\\_calendar](https://pub.dev/packages/syncfusion_flutter_calendar)

- [21] Upwork | Hire Freelancers. Make things happen." [Online]. Available: <https://www.upwork.com/>. (Accessed: September 15, 2023).
- [22] Stack Overflow - Where Developers Learn, Share, & Build Careers. [Online]. Available: <https://stackoverflow.com>. (Accessed: September 15, 2023).
- [23] GitHub," [Online]. Available: <https://github.com>. (Accessed: September 15, 2023).
- [24] W3Schools Online Web Tutorials". [Online]. Available: <https://www.w3schools.com>. (Accessed: September 15, 2023).
- [25] Microelectronics winter camp الرئـيسية الصـفـحة. Available at: <https://www.hackathonat.com/> (Accessed: 15 September 2023)
- [26] Liu, J. (2023) Is ChatGPT a Good Recommender? A Preliminary Study. tech. Available at: <https://arxiv.org/abs/2304.10149v3>.
- [27] Custom instructions for chatgpt (no date) Custom instructions for ChatGPT. Available at: <https://openai.com/blog/custom-instructions-for-chatgpt> (Accessed: 02 December 2023).
- [28] Shneiderman, B. et al. (2018) Designing the user interface: Strategies for effective human-computer interaction, Amazon. Available at: <https://www.amazon.com/Designing-User-Interface-Human-Computer-Interaction/dp/013438038X> (Accessed: 29 November 2023).
- [29] Search (2013) 10 Usability Heuristics for User Interface Design | Design Principles FTW. Available at: <https://www.designprinciplesftw.com/collections/10-usability-heuristics-for-user-interface-design> (Accessed: 27 November 2023).
- [30] "Understanding TF-IDF: A Simple Introduction." MonkeyLearn Blog, 10 May 2019, [monkeylearn.com/blog/what-is-tf-idf/#:~:text=TF%2DIDF%20\(term%20frequency%2D](https://monkeylearn.com/blog/what-is-tf-idf/#:~:text=TF%2DIDF%20(term%20frequency%2D).
- [31] Hybrid recommendation. hybrid recommendation - an overview | ScienceDirect Topics. (n.d.). <https://www.sciencedirect.com/topics/computer-science/hybrid-recommendation#:~:text=A%20hybrid%20recommendation%20the%20framework,Adomavicius%20and%20Tuzhilin%2C%202005>
- [32] design tools. (n.d.). RiveAnimation. Flutterflow.Io. Retrieved November 21, 2023, from <https://docs.flutterflow.io/widgets-and-components/widgets/base-elements/riveanimation>
- [33] HTTP: Dart Package (2024) Dart packages. Available at: <https://pub.dev/packages/http> (Accessed: 18 May 2024).

[34] Crypto: Dart package (2023) Dart packages. Available at: <https://pub.dev/packages/crypto> (Accessed: 18 May 2024).

[35] “Usability Questions: How to Ask Effective Questions.” Maze, [maze.co/guides/usability-testing/questions/](https://maze.co/guides/usability-testing/questions/).

[36] Hamilton, Thomas. “What Is Usability Testing? UX(User Experience) Testing Example.” Guru99.com, 18 Nov. 2019, [www.guru99.com/usability-testing-tutorial.html](https://www.guru99.com/usability-testing-tutorial.html).

[37] Thomas, Nathan. “How to Use the System Usability Scale (SUS) to Evaluate the Usability of Your Website - Usability Geek.” Usability Geek, 15 Jan. 2019, [usabilitygeek.com/how-to-use-the-system-usability-scale-sus-to-evaluate-the-usability-of-your-website/](https://usabilitygeek.com/how-to-use-the-system-usability-scale-sus-to-evaluate-the-usability-of-your-website/).

[38] ---. “What Is Usability Testing? UX(User Experience) Testing Example.” Guru99.com, 18 Nov. 2019, [www.guru99.com/usability-testing-tutorial.html](https://www.guru99.com/usability-testing-tutorial.html).

[39] “Handling Errors in Flutter.” Docs.flutter.dev, docs.flutter.dev/testing/errors. Accessed 20 May 2024.

[40] “Security Testing (a Complete Guide).” [Www.softwaretestinghelp.com, www.softwaretestinghelp.com/how-to-test-application-security-web-and-desktop-application-security-testing-techniques/](https://www.softwaretestinghelp.com/how-to-test-application-security-web-and-desktop-application-security-testing-techniques/).

[41] “Firebase Authentication Password Hashing.” Firebase Open Source, [firebaseopensource.com/projects/firebase/scrypt/](https://firebaseopensource.com/projects/firebase/scrypt/).

[42] altexsoft. “Non-Functional Requirements: Examples, Types, How to Approach.” AltexSoft, 26 July 2022, [www.altexsoft.com/blog/non-functional-requirements/](https://www.altexsoft.com/blog/non-functional-requirements/).

[43] “Service Level Agreement for Hosting and Realtime Database.” Firebase, [firebase.google.com/terms/service-level-agreement#:~:text=1..](https://firebase.google.com/terms/service-level-agreement#:~:text=1..) Accessed 20 May 2024.

## 9 Appendix

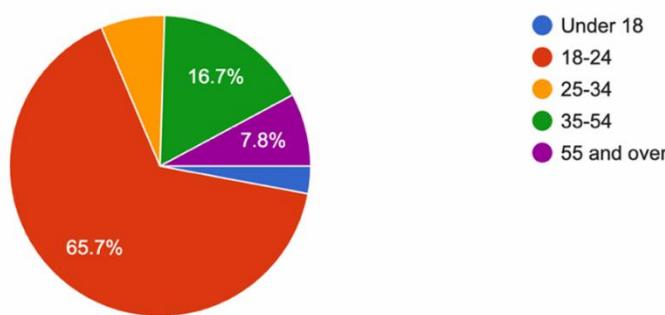
### 9.1 Appendix A

#### Requirement Elicitation:

Questionnaire results:

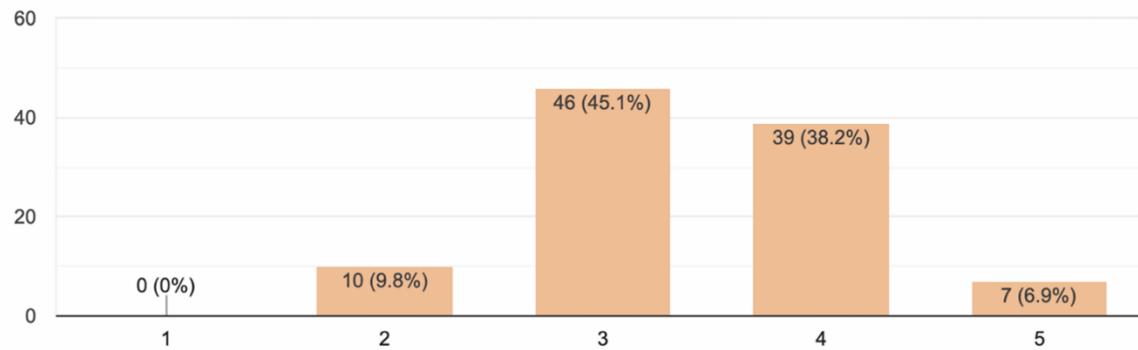
##### 1- What is your age?

102 responses



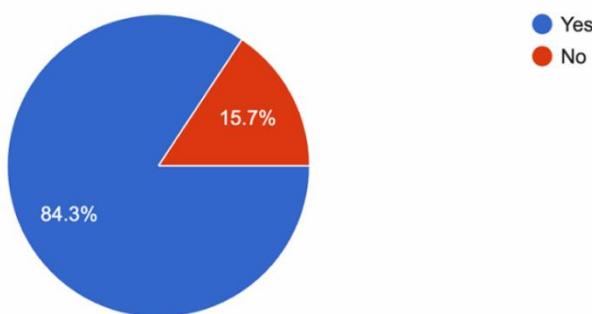
##### 2- How would you rate your current technical proficiency?

102 responses



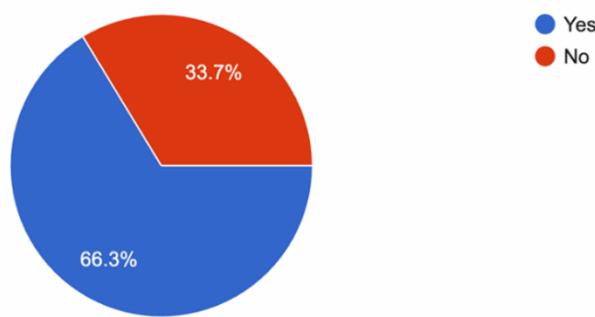
##### 3- Do you seek help on popular platforms like Stack Overflow when facing technical problems?

102 responses



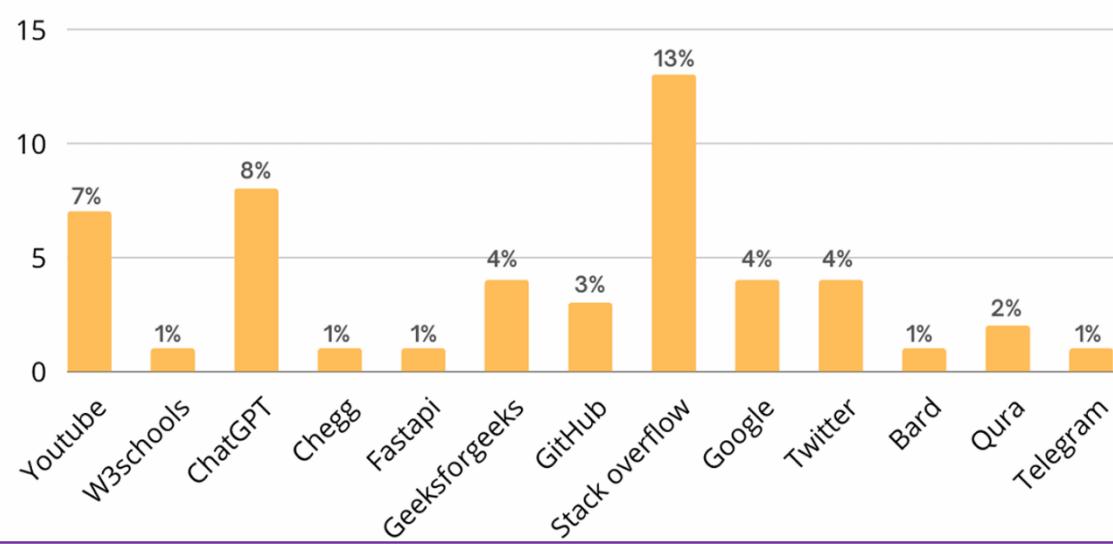
**4-If yes , is it hard looking for resources to technical problems or inquiries ?**

92 responses



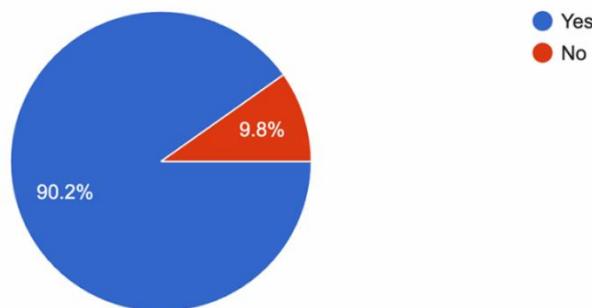
**5- If yes, what platform do you use to find solutions?**

37 responses



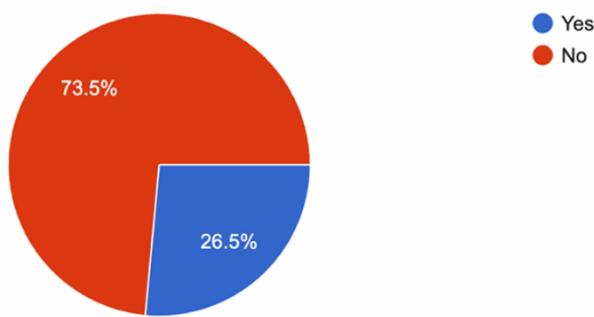
**6- Can having a supportive community for public discussions and assistance help you find the information you need?**

102 responses



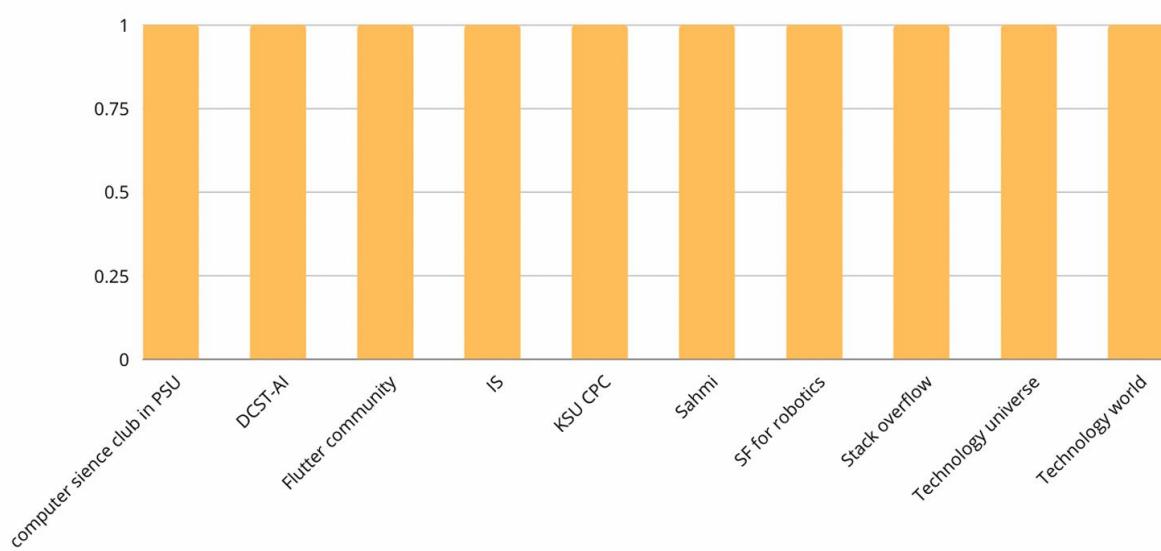
**7- Are you currently a member of any technical community?**

102 responses



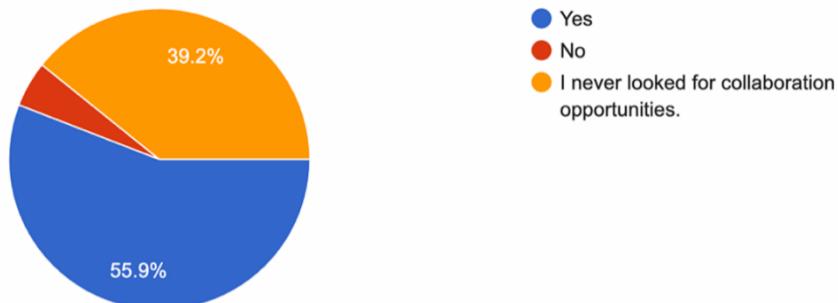
**8- If yes, please mention the name of the community.**

14 responses



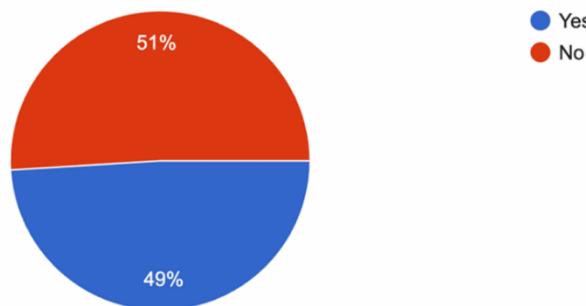
**9- Do you face difficulties finding collaboration opportunities, such as forming a team for hackathons or technology-related competitions?**

102 responses



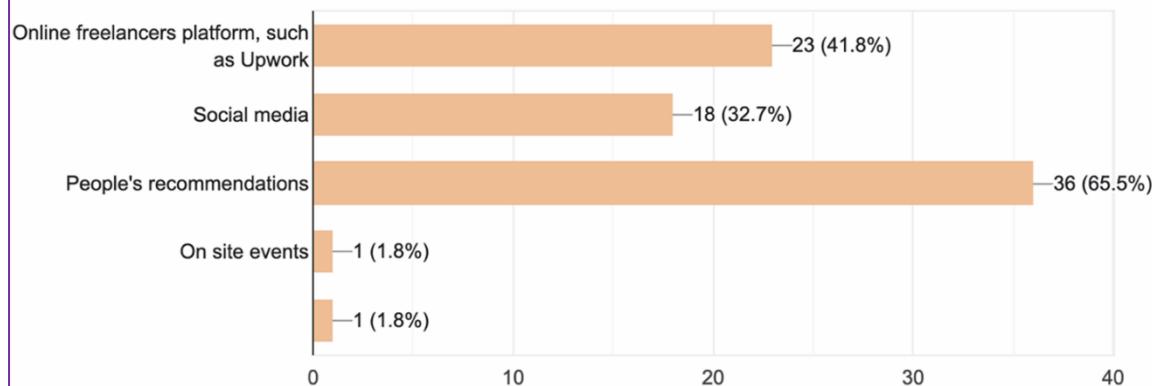
10- Have you previously engaged in collaboration with a freelancer, such as hiring them to complete a project or task for you?

102 responses



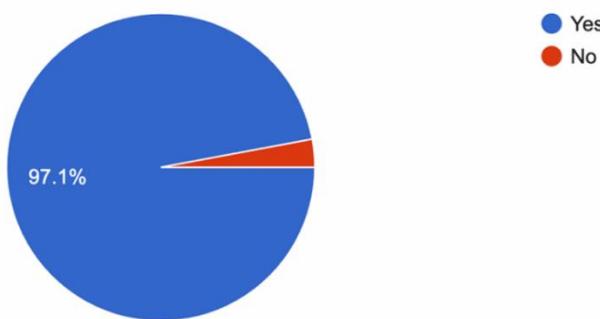
11- If yes, how did you find them?

55 responses



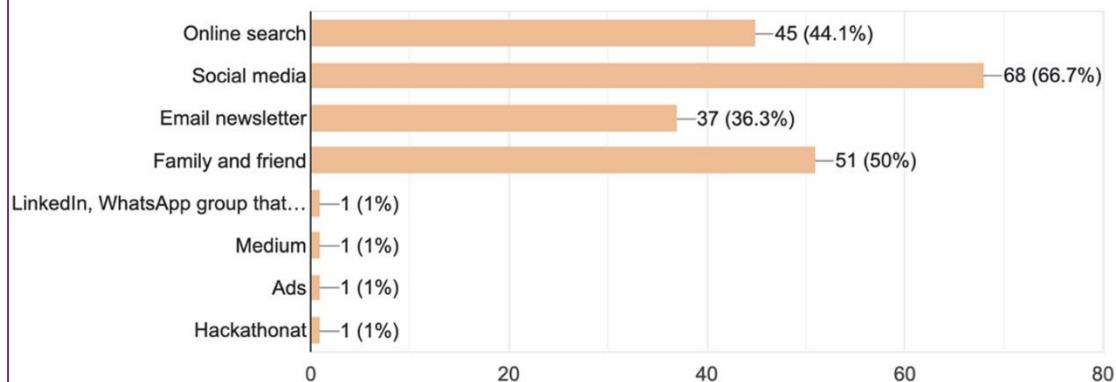
12- Are you interested in discovering the latest courses and events in your technology fields of interest?

102 responses



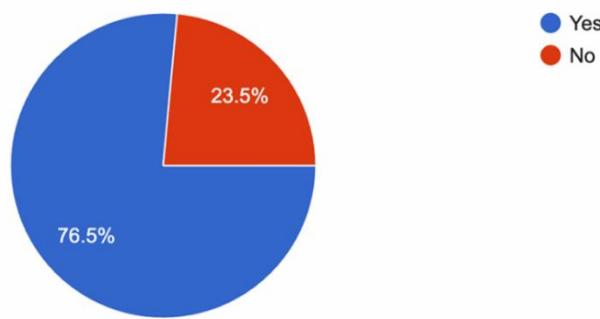
### 13- How do you typically find information about the latest events and courses?

102 responses



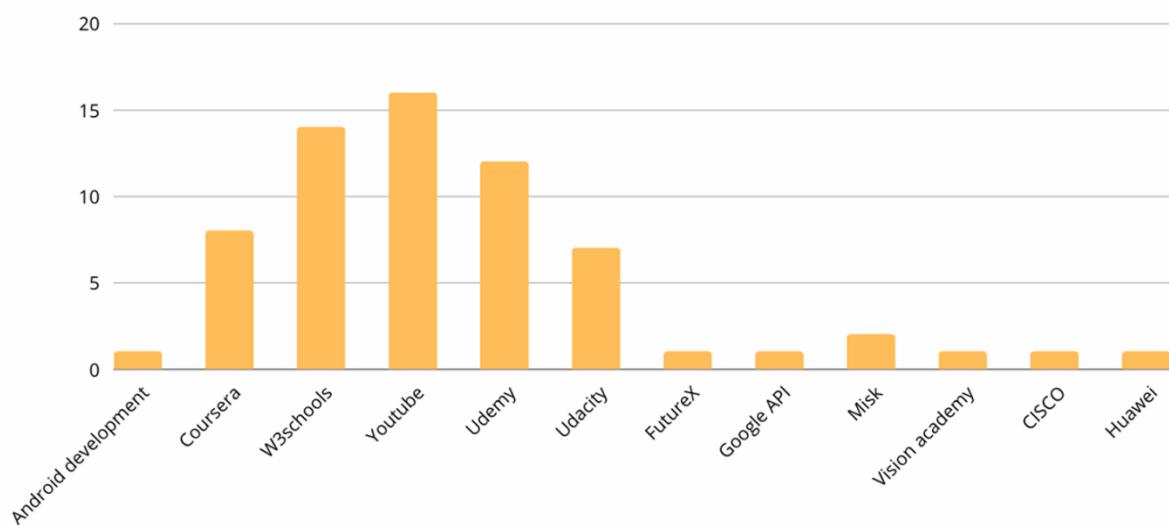
### 14- Have you ever used a platform to help you learn something new related to technology , such as : new tools , new skills , new programming language from A-Z?

102 responses



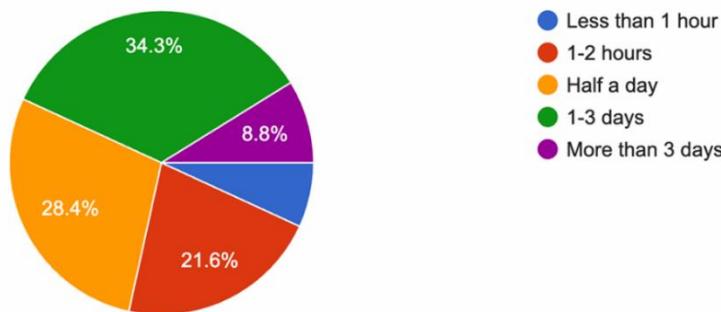
### 15- If yes, what platform did you use?

57 responses



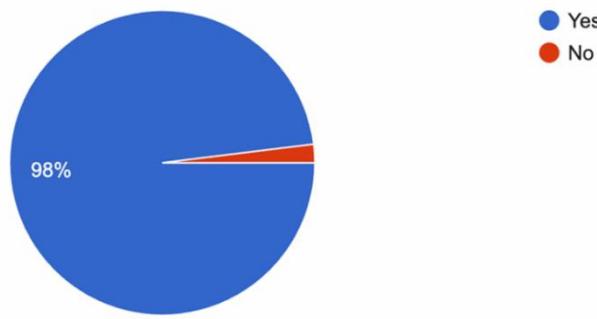
16- How much time does it typically take you to find the right resources when learning a new technical skill or technology from A-Z?

102 responses



17- Imagine having an application that combines a variety of technology-related courses and events, a platform for asking questions and receiving comm...d you be interested in using such an application?

102 responses



- **Questionnaire link:**

[https://docs.google.com/forms/d/1xeFr1T6TI7\\_Mg1fLdis5LJQ23Am0f4M8mSBbBmBaRCo/edit#responses](https://docs.google.com/forms/d/1xeFr1T6TI7_Mg1fLdis5LJQ23Am0f4M8mSBbBmBaRCo/edit#responses)

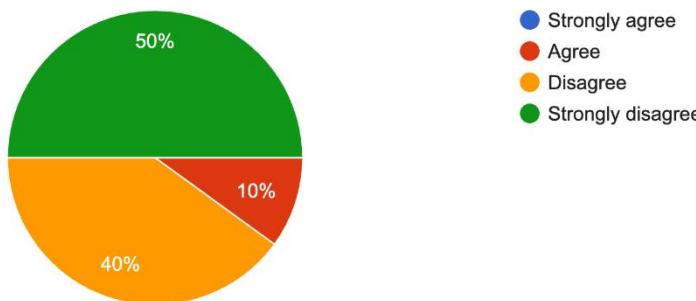
## 9.2 Appendix B

### UAT:

Questionnaire results:

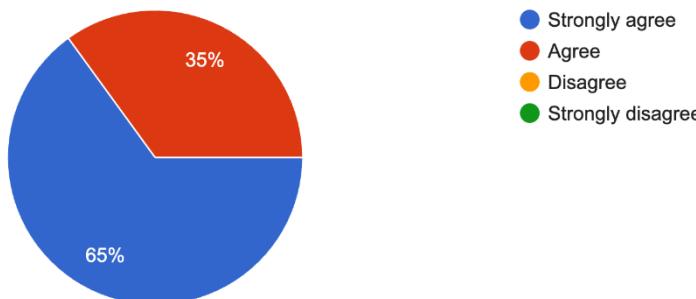
I needed previous experience to use the app.

20 responses



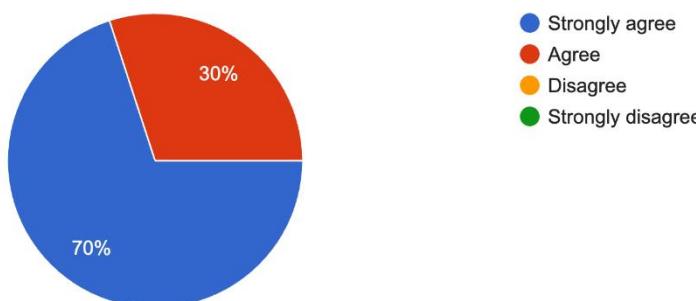
I found the app easy to use. I found the app to be properly threaded and navigating between pages was easy.

20 responses



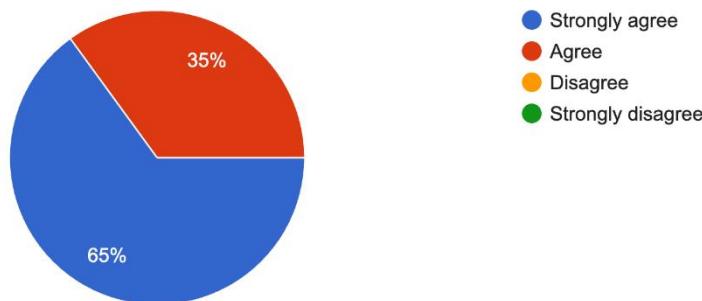
I found the colors comfortable.

20 responses



I found the application interface design clear and easy to use.

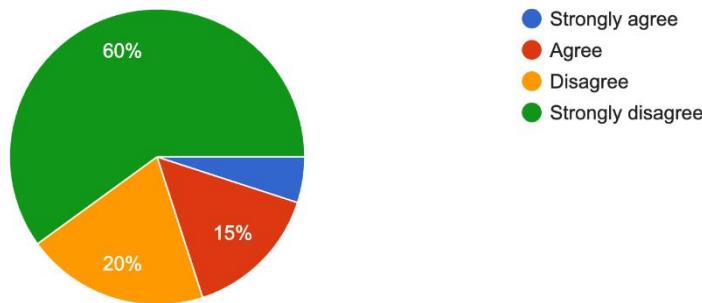
20 responses



- Strongly agree
- Agree
- Disagree
- Strongly disagree

I found that some of the icons did not have a clear meaning.

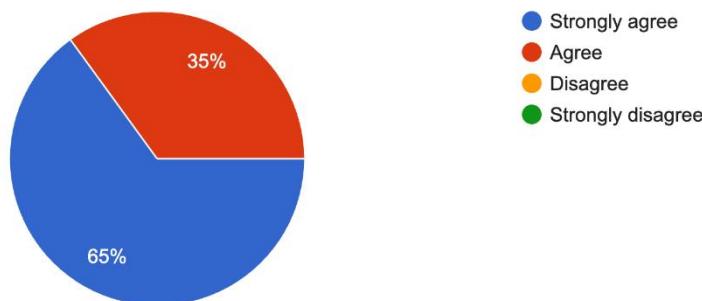
20 responses



- Strongly agree
- Agree
- Disagree
- Strongly disagree

I found the app to have a fast response.

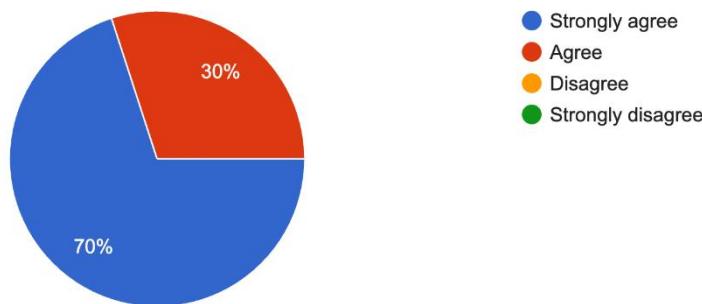
20 responses



- Strongly agree
- Agree
- Disagree
- Strongly disagree

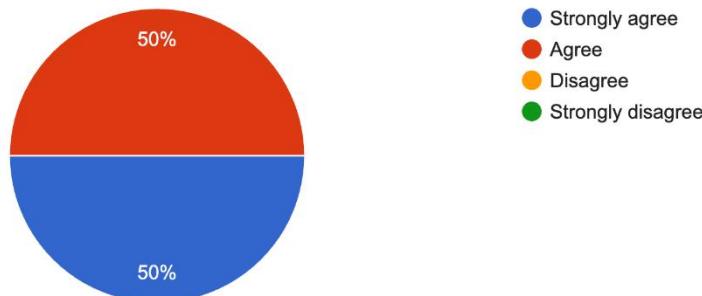
I think I will use the app frequently.

20 responses



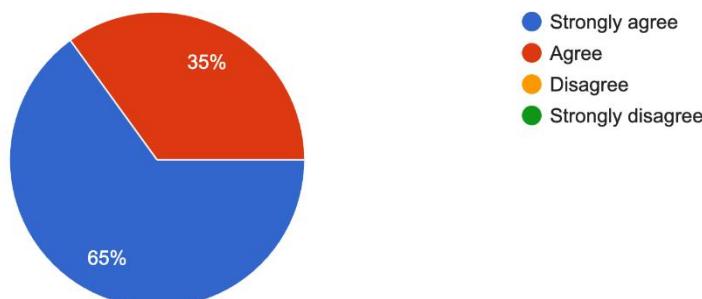
I was able to post a question, team collaboration, project correctly, easily, and clearly.

20 responses

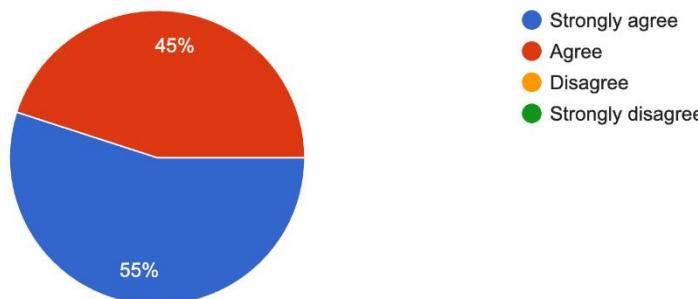


I was able to search for a post correctly, easily, and clearly.

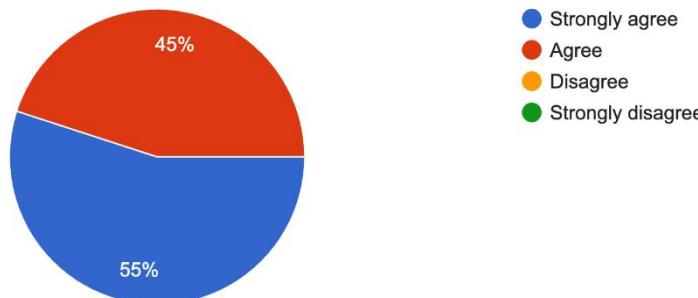
20 responses



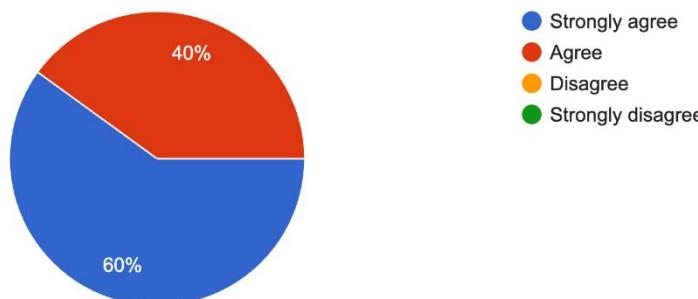
When I viewed the home page, the recommended questions were useful to me.  
20 responses



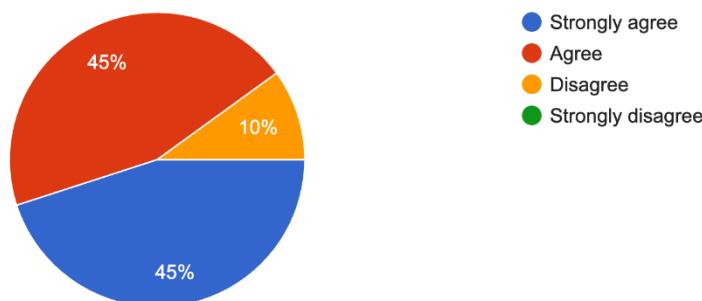
I was able to chat with other users through private messages correctly, easily, and clearly.  
20 responses



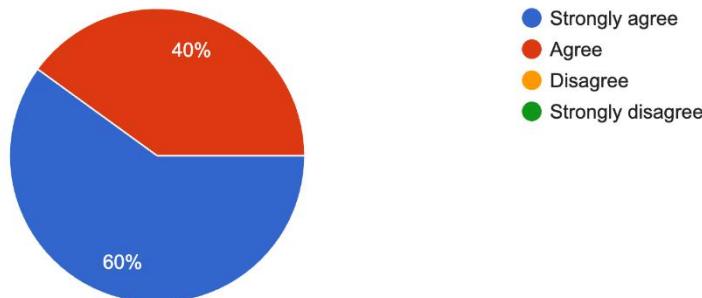
I was able to post course/event correctly, easily, and clearly.  
20 responses



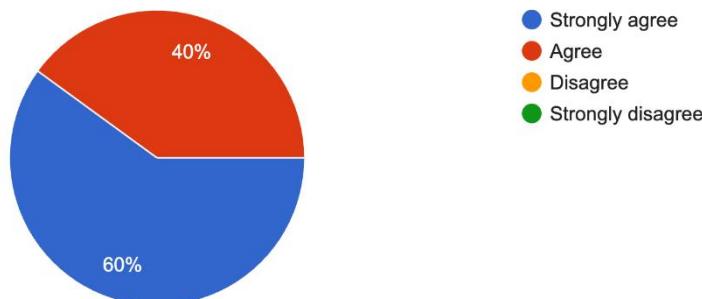
When I viewed the explore page, the recommended courses and events were useful to me.  
20 responses



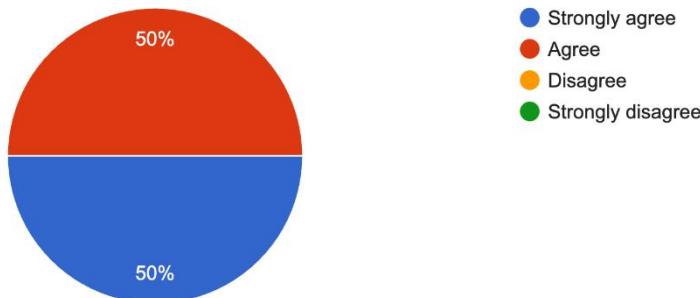
I was able to explore pathways correctly, easily, and clearly.  
20 responses



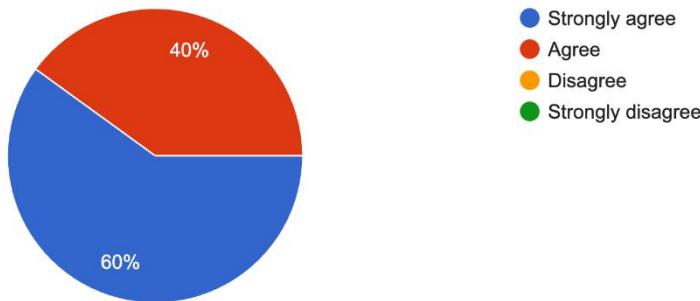
I was able to view all freelancers in one page correctly, easily, and clearly.  
20 responses



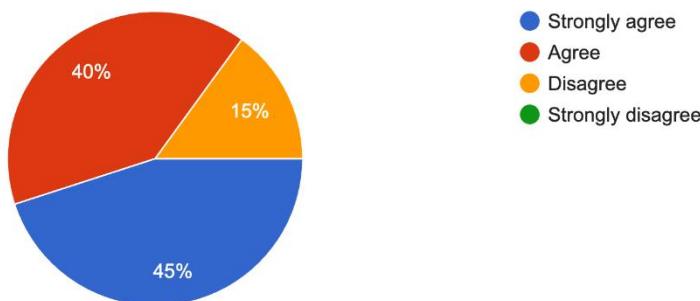
I was able to add specific question to bookmark correctly, easily, and clearly.  
20 responses



I was able to add specific course/event to my calendar correctly, easily, and clearly.  
20 responses

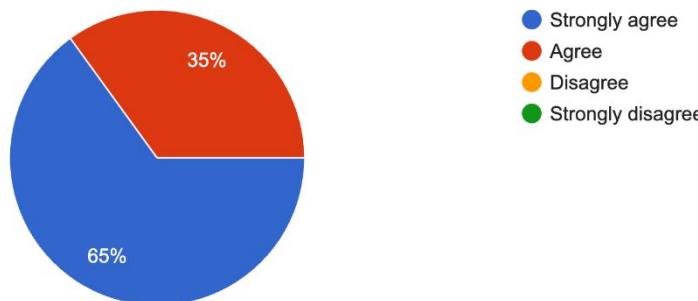


I was able to view my interactions correctly, easily, and clearly.  
20 responses



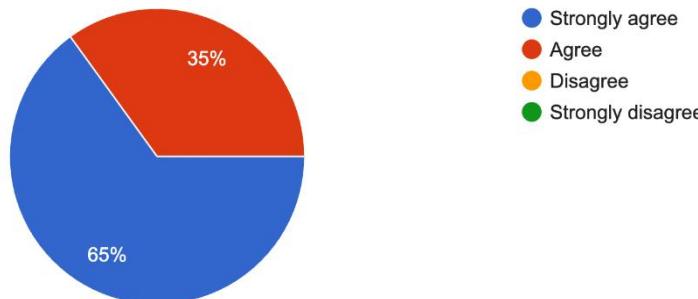
I was able edit my profile correctly, easily, and clearly.

20 responses



The pop-up messages I get from the app were helpful and clear.

20 responses



We will be pleased with your suggestions and comments:

6 responses

i wish it supports Arabic language

add more recommendations to the app

everything is perfect

great application and great idea

I wish if I could edit my posts

i felt like the app was similar to social media platforms like twitter and that's a good thing! i just wish we had more control over choosing account header and bio

- Questionnaire Link:**

[https://docs.google.com/forms/d/e/1FAIpQLScbmMxqagtBeJx\\_eLwqXmuTmnPoOtkIQieDle98FzHKeYQKw/viewform?usp=sharing](https://docs.google.com/forms/d/e/1FAIpQLScbmMxqagtBeJx_eLwqXmuTmnPoOtkIQieDle98FzHKeYQKw/viewform?usp=sharing)

### 9.3 Appendix C

#### NFR Usability Test:

- SUS questions:

I think I would like to use the system frequently *					
1	2	3	4	5	
Disagree vehemently	<input type="radio"/> Agree completely				
I found the system unnecessarily complicated *					
1	2	3	4	5	
Disagree vehemently	<input type="radio"/> Agree completely				
I thought the system easy to use *					
1	2	3	4	5	
Disagree vehemently	<input type="radio"/> Agree completely				

I think that I need the support of technical person to be able to use the system \*

1	2	3	4	5		
Disagree vehemently	<input type="radio"/>	Agree completely				

I found the various functions in the system were well integrated \*

1	2	3	4	5		
Disagree vehemently	<input type="radio"/>	Agree completely				

I thought there was too much inconsistency in the system \*

1	2	3	4	5		
Disagree vehemently	<input type="radio"/>	Agree completely				

I would imagine that most people would learn to use the system in short time \*

1	2	3	4	5		
Disagree vehemently	<input type="radio"/>	Agree completely				

I found the system very cumbersome to use \*

1	2	3	4	5		
Disagree vehemently	<input type="radio"/>	Agree completely				

I felt very confident using the system \*

1	2	3	4	5		
Disagree vehemently	<input type="radio"/>	Agree completely				

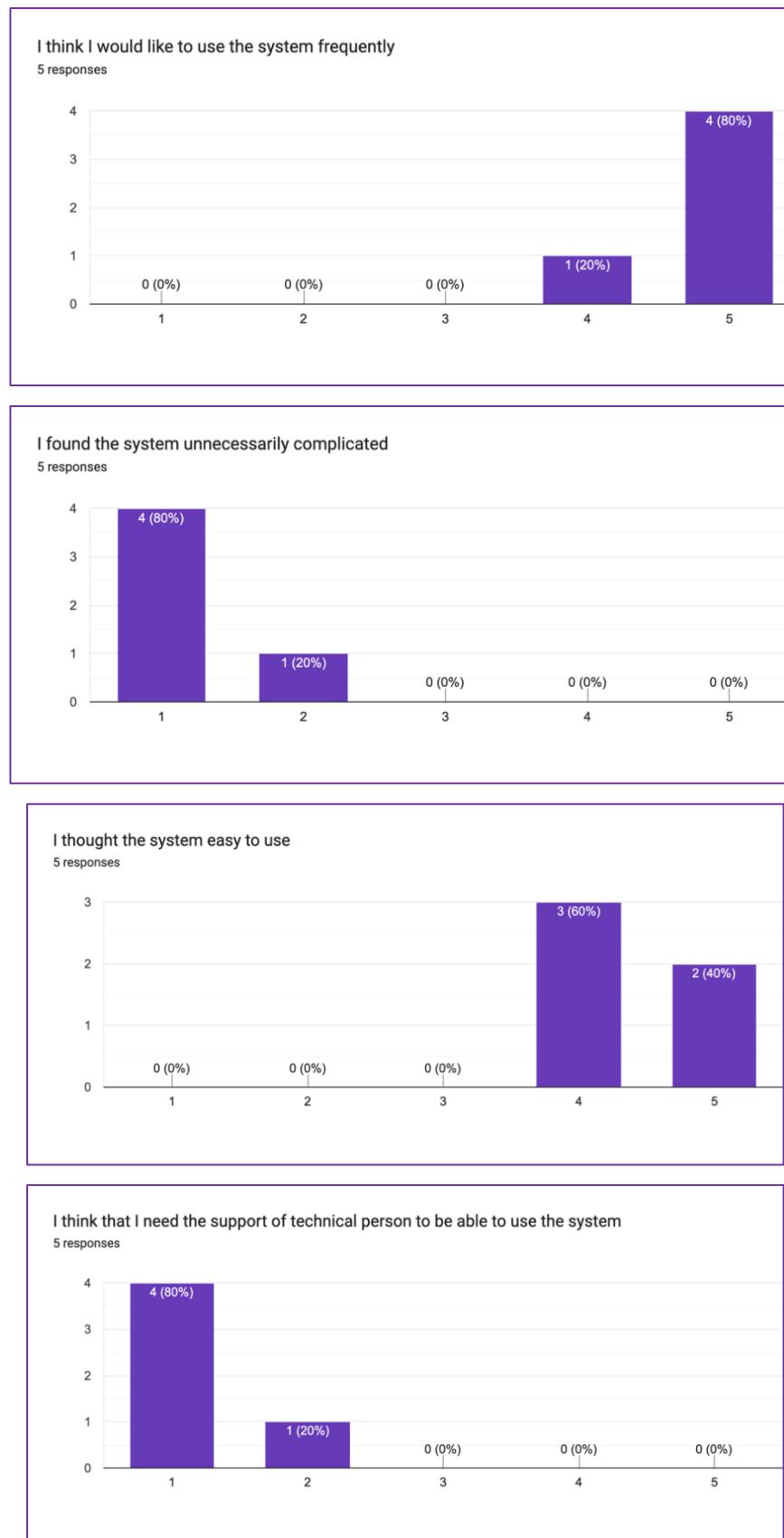
I felt very confident using the system \*

1	2	3	4	5		
Disagree vehemently	<input type="radio"/>	Agree completely				

I need to learn a lot of things before I could get going with the system \*

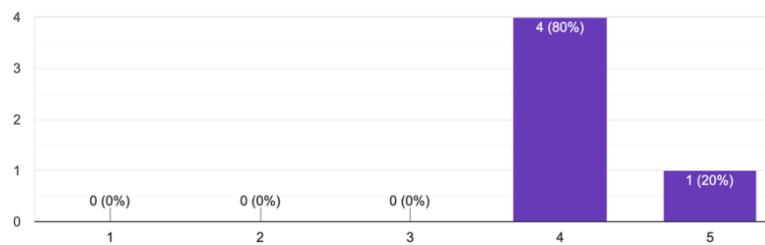
1	2	3	4	5		
Disagree vehemently	<input type="radio"/>	Agree completely				

- SUS results:



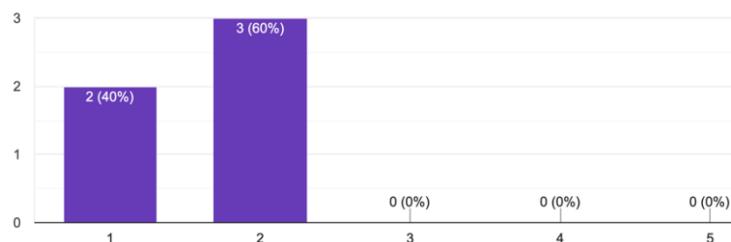
I found the various functions in the system were well integrated

5 responses



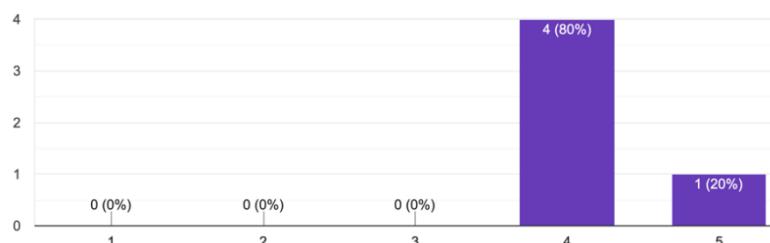
I thought there was too much inconsistency in the system

5 responses



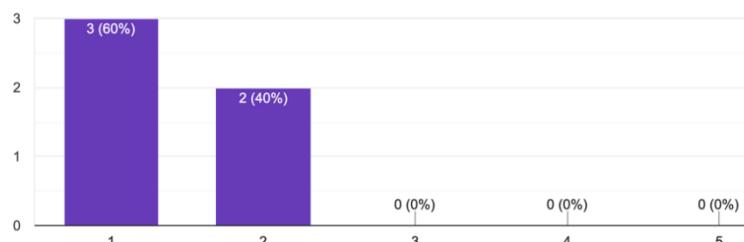
I would imagine that most people would learn to use the system in short time

5 responses



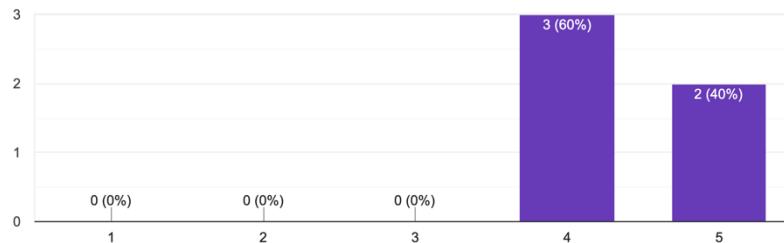
I found the system very cumbersome to use

5 responses



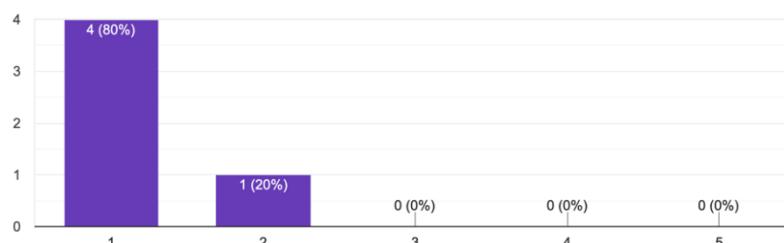
I felt very confident using the system

5 responses



I need to learn a lot of things before I could get going with the system

5 responses



- **Questioner Link:** [https://docs.google.com/forms/d/e/1FAIpQLSc664V-9QoMC9nT-BPM2D\\_GWPUI-BfqFnccEWPUDDWox2nNGg/viewform?usp=sharing](https://docs.google.com/forms/d/e/1FAIpQLSc664V-9QoMC9nT-BPM2D_GWPUI-BfqFnccEWPUDDWox2nNGg/viewform?usp=sharing)