بسم الله الرحمن الرحيم

An-Najah National University

Faculty of Engineering and Information Technology

Computer Engineering Department

Graduation Project I

CEE-Learning

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Chapter 1

Abstract

Many Electrical and Computer Engineering students at the university seek revision before exams, private sessions for discussing their materials, or advice pertaining to projects. In light of this, our project aims to support them by creating an application that facilitates efficient time utilization for experts and provides scientific benefits to students.

Many functionalities are provided through the app:

- The expert can put the areas in which he excels, and encloses that in certificates.
- The expert has a calendar where they can mark their availability, enabling students to reserve appointments according to the expert's schedule.
- Students can book appointments, view their bookings, and access details about the expert through our calendar.
- Experts can view the students who have booked appointments and access information about them.
- Experts can conduct online meetings with students using our application's meeting feature, which allows students to join the meetings.
- All users can post questions, and other users can reply to them or search for any question.
- Users can communicate with each other through the chat feature.
- Experts receive notifications to stay informed about their booked appointments.
- Students can search for experts by writing statements related to specific expert descriptions.
- Users have the ability to rate experts and view their ratings.
- The system displays the availability rooms of Engineering College at An-Najah National University and enables users to make bookings.
- The Natural language processing understands what the user is typing while searching for something specification.
- A recommendation system suggests similar experts based on students' interests using a cosine similarity .

- Nn administrative page on our website, which is capable of displaying user information and facilitating the deletion of such data. Furthermore, the administrator has the ability to access a chart showcasing the earnings.

We have identified several applications that resemble parts of our own application. However, these features are currently scattered across multiple applications. Our goal is to consolidate all these features, along with additional new ones, into a single integrated application. This unified approach will greatly enhance user experience and make it much easier for users to navigate and utilize the application.

The project consists of a mobile application designed for users, along with a website accessible to both the admin and users. To develop the application and website, a variety of tools and frameworks were utilized. Specifically, the Flutter framework, which is built on the Dart programming language, was employed to create a cross-platform mobile application and website. Further details regarding this will be discussed in the methodology section.

Chapter 2

Introduction

2.1 Problem

Many students often face challenges when they need to ask questions about their course materials, discuss problem-solving errors with experts, seek revision assistance before exams, or consult someone regarding their projects. Unfortunately, there are instances where experts have ample free time but do not utilize it effectively. Additionally, students often struggle to locate the appropriate experts, and finding a suitable place for their discussions can be difficult. Moreover, when someone needs to ask Electrical and computer engineering-related questions and desires a specialist's response, the process can be cumbersome.

2.2 Objective

Our main objective with this project aims to create a seamless and productive environment for academic support, emphasizing efficient appointment scheduling, personalized guidance, active community engagement, transparency, and the convenience of room bookings.

2.3 Scope Of the Work

Our application focuses on the field of computer engineering ,electrical engineering and everything related to them. We provide students with the opportunity to ask questions, join meetings, make room reservations within the Engineering College at An-Najah University, and benefit from the various services offered by our application. Moreover, we offer experts a valuable opportunity to effectively utilize their free time. Additionally, experts have the option to conduct seminars in the designated rooms of the Engineering College at An-Najah University through prior reservations.

2.4 Importance

Communication plays a vital role in our lives, particularly in the field of Electrical and computer engineering. Whether it's seeking expert advice, making inquiries, or asking questions about specific topics or projects related to Electrical and computer engineering , effective communication is essential. However, finding the desired expert can be challenging, especially when specialized knowledge in a specific Electrical and computer engineering sub-field is required.

This intricacy further compounds the difficulty of the situation, emphasizing the importance of streamlined and efficient communication channels in the Electrical and computer engineering domain. From this point of view, the idea came to our mind, we aim to provide students with the opportunity to find the suitable Electrical and computer engineering expert according to their desired specialization. This benefits both the student and the expert, as the student can access the expertise they need, while the expert can utilize their free time effectively. This way, the investment is realized for the users. Here was the source of the idea, The expert can put all the information through which he supports his page in it, from education, skills, certificates and talents, through which the student determines whether he wants to book with that expert or not, and there is also a evaluation system for the expert that enables the student to choose the expert correctly, but not only that, there is also an opportunity to ask questions in the field of Electrical and computer engineering, and any user can answer these questions as a form of assistance. Experts can also conduct seminars for students on specific topics in Electrical and computer engineering by reserving a room in the Engineering College at An-Najah University. Addition- ally, students can also book a room in the Engineering College at An-Najah University for studying or similar purposes. In addition, users can perform a search by selecting a phrase that defines the type of computer engineering expert or electrical engineering expert that you are looking for, and the search phrase is understood, whatever it is, through Natural Language Processing, and when the student makes a reservation for a specific expert, a list of experts appears on the student's page Those who have the same experience and skills as the expert who booked him, through the use of cosine similarity. Through this application, the expert sets their availability on the calendar at the desired price for the desired duration. The student selects any available and unreserved appointment slot and pays for it using a credit card. For the student, they have their own calendar that displays their booked appointments and provides information about each expert they have booked with. As for the expert, they can see the information of the students who have booked with them. When the appointment time arrives, there is a meeting feature within the application that allows the student and the expert to discuss what the student wants, specifically what was written in the description when booking on the expert's calendar. Additionally, the student can also choose an expert based on their ratings received from other students.

2.5 Report Organization

This report is organized as the following, Chapter1:The Abstract of our project, then in Chapter2: an introduction and overview about the importance and the scope of this project.In Chapter3: the problems and constraints that we faced in this project, Chapter4:literature review, Chapter5:the methodology used to complete the project. In Chapter 6: We explained in detail about the machine learning model, all the tools and languages used to design it, and how we used it in our application. Chapter7:Result and discussion, Chapter8: Conclusion and recommendation.

Chapter 3

Constraints, Standards and Earlier coursework

3.1 Constraints and limitations

1. Compilation of features: We tried to have our application familiar with all the features that the student needs in order to receive what he wants easily, so it was necessary to think deeply and conclude the best features to include them in the project.

2. Time limit: We had to learn new programming languages like Dart and mobile frameworks like flutter, as well as back-end frameworks like Node.js, since this is the first time we are creating a mobile application and we haven't learned it in previous courses. In order to use the Firebase Database, a cloud-hosted database, we also had to become familiar with it and learn how to use it. MongoDB database is something else we study and work with. This was more challenging than normal because we were working under pressure because we had other commitments, but we attempted to make everything we learned familiar to us in order to use the features and to program appropriately.

3. Quality of the training dataset: The caliber of the training dataset is what determines how accurate the machine learning model will be. The ML Model performs better in general with larger data sets. Seventy samples make up the short dataset that was utilized to train the model. The expert that the user book in to also affects how accurate the outcome will be.

4. Internet connection: Always having an online connection is necessary for our application. The JSON requests are responsible for this.

3.2 Standards

3.2.1 MVC (Model View Controller)

The Model-View-Controller (MVC) pattern was employed in our system. We split the entire project into three parts, making it easier to track the flow of work. These components are: as follows:

- The Model: It represents the database we used, MongoDB. It is also in the ML model which is the recommendation system which is based on a detailed data model that includes all the necessary details about the experts and their profiles, which uses this

data for training.The Model responds to both the requests from the view and the controller to keep itself updated.

- The View: It represents the graphical user interface (GUI) that will be used by users such as admins, students, and experts. It allows them to make reservations, manage bookings, inquire through questions, rate and search
- The Controller: It represents the back-end server built with Node.js for the application and website. It also serves as the server for the detection model. The controller facilitates coordination and cooperation between the Model and the View.

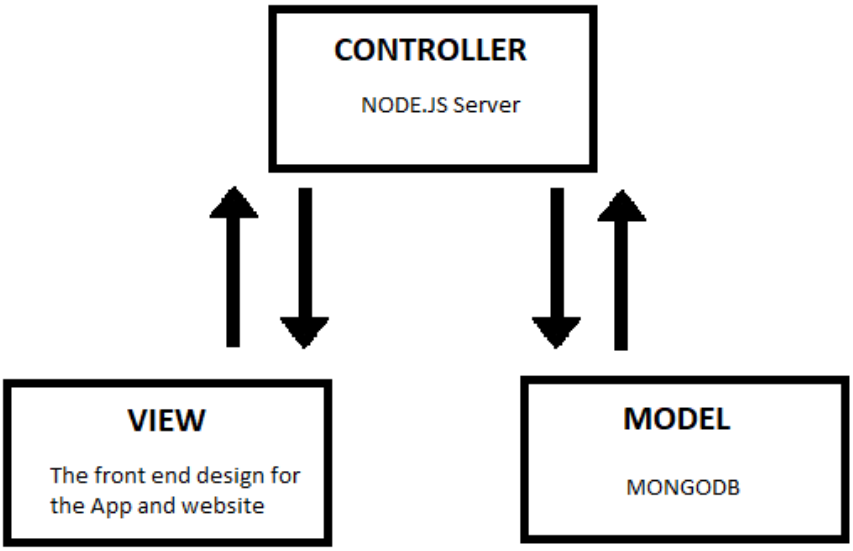


Figure 3.1: MVC Structure of the system.

3.2.2 Agile Model

We utilized the Agile model methodology to design and document our software system. We segmented the tasks into five stages, which include:

- Stage 1: Requierment analysis:

  During this stage, we engaged in brainstorming sessions and identified the fundamental features that we aim to offer through the application.

- Stage 2: Planing:

  We have established a timeline for completing the checks, with each task assigned a specific time-frame. Once a task is completed, it is reviewed and discussed with the project supervisor.

- Stage 3: Design the requirements:

  The project work was divided based on prioritization, with higher priority tasks being addressed first. There were almost daily meetings to review progress, discuss upcoming

work, and address any challenges encountered to facilitate their resolution. Additionally, each component of the project was divided into user stories to plan the why, for whom, and what of each desired feature.

- Stage 4: Development:

  For this phase, we began writing the code for both the front end and back end of each page. Additionally, we trained our recommendation system model to be used within our application.

- Stage 5: Testing:

  First, we verify the functionality of the back-end by testing it in Postman and ensure that it works correctly. Then, we establish the connection between the back-end and front-end to ensure that every page functions correctly. Additionally, we perform tests to assess the accuracy of our machine learning model.

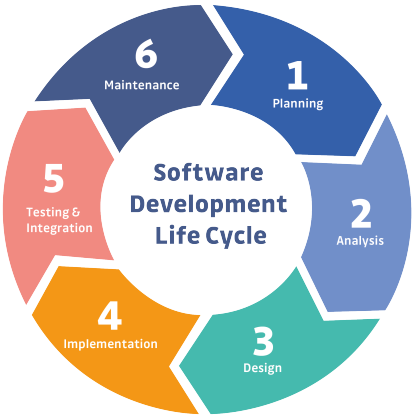


Figure 3.2: Applying Agile model.

3.3 Earlier coursework

During our Computer Engineering studies, we enrolled in several courses that provided us with valuable knowledge and skills. These courses included Web Programming, Object-Oriented Programming, and the Database course, which served as a foundation for learning front-end and back-end development and working with real databases. Additionally, the Software Engineering and Advanced Software courses were instrumental in helping us adhere to software engineering standards while writing our code. The knowledge gained from these courses greatly contributed to our project and accelerated the programming process, allowing us to rely on our existing knowledge rather than constantly referring to external resources. Furthermore, at the beginning of the semester, we independently learned Flutter, Dart, Node.js, MongoDB,Flask,and Firebase, which further expanded our expertise in software development.

Chapter 4

Literature Review

In-depth research in the literature has been done on the efficiency of digital technological solutions in education. Numerous studies have looked into how e-learning platforms and blended learning models affect the educational process, focusing on diverse factors such organizational structure, student engagement, collaboration, and instructional design.

The need of organizing the IT function within educational institutions is emphasized by Agarwal and Sambamurthy (2002). They underline the importance of strategic planning and the need to match IT activities with educational objectives in order to effectively promote the integration of technology in education.(2)

Computer conferencing in higher education and its potential for critical inquiry are topics covered in depth by Garrison, Anderson, and Archer (2000). The study emphasizes the value of text-based collaboration and communication in promoting student intellectual engagement and deep learning.(3)

Graham (2006) goes into more detail on blended learning systems, outlining the idea, present tendencies, and prospective directions. The author examines numerous blended learning models and strategies, highlighting both their advantages and disadvantages. To enhance learning outcomes, the study underlines the requirement for effective online and face-to-face component integration.(4)

In computer-supported collaborative learning (CSCL) environments, So and Bonk (2010) concentrate on the functions of blended learning approaches. The authors consult experts using a Delphi research to determine the main advantages and benefits of blended learning in promoting student collaboration and knowledge construction.(5)

In conclusion, the literature emphasizes how important E-learning platforms and digital technological innovations are in revolutionizing the educational landscape. Educational institutions can develop tailored and interesting learning environments by being well-organized, using blended learning models, encouraging student interaction and collaboration, and implementing feedback mechanisms. We can improve the whole educational experience and enable students to realize their full potential by bringing technology into the classroom.

Chapter 5

Methodology

In this section, we provide a detailed explanation of the methodology as following :

5.1 Backend Development

We used specific architecture in our Node.js application during the development phase. The services, models, API, and middleware folders in the backend source were grouped to represent the structure components.

- Models:The models in our application reflected the underlying collections and data structures in the MongoDB database. To design and communicate with our models, we used the Mongoose library, which offers an Object Data Modeling (ODM) layer for MongoDB. We were able to construct schemas with Mongoose, which governed the structure, validation guidelines, and behavior of our data..

- Services:Services acted as the layer of communication between controllers and models. They handled data manipulations, engaged with external APIs when needed, and contained the application's business logic. We put in place a number of services, such as User Service for user-related tasks and Rates Service for Rating.

- API:To expose the backend functionality, we created and developed a RESTful API. The API had a number of well defined endpoints, each of which corresponded to a different action or resource. We used the necessary HTTP methods (such as GET, POST, PUT, and DELETE) for each endpoint while adhering to REST principles. Our API provided a number of functions including user login, appointment scheduling, and user data retrieval.

- Middleware:For handling authentication, middleware was crucial in our application. We put in place a middleware piece that is solely responsible for verifying incoming requests. Requests were intercepted by this middleware, which also checked the requester's identity. To secure our API endpoints, we employed a commonly known authentication method called JSON Web Tokens (JWT). In order to confirm that the user was authenticated and permitted to access protected routes, the middleware verified the JWT contained in the request headers. The middleware provided the necessary error answers in the event that the tokens were invalid or expired.

5.2 Frontend Development

We used the Flutter framework to build the front end for the web site and mobile application which prevented us from having to write duplicate code and saved us time.

- The design:we first decided on the colors to give it an official and educational feel. We went with blue, white, and gray, and we pulled some interface ideas from the Linkedin and Facebook websites because they are somewhat comparable to our idea

- Frameworks: Our choice to employ Flutter, a Google open source framework, was made after careful consideration of all of its qualities, the most crucial of which is its effective performance. Code can be exchanged between target systems thanks to a cross-platform framework. There are no other application frameworks besides Flutter that let you share both the code and the actual user interface,Additionally, because it is open source, there are numerous documentation and courses that can be studied and profited from, which speeds up the learning process and makes it easier to solve the problems that programmers frequently encounter. In conclusion, Flutter is the simplest way to generate speedier code developers with high-performing cross-platform mobile apps.

- Programming languages:Dart is a programming language that Google created with web and mobile application developers in mind. It may be used to create applications for Android and iOS. The language aims to function on all cutting-edge online browsers, mobile devices, and even web servers. It is obvious that we will use Dart as we'll be leveraging the flutter framework.

5.3 Database Design and Configuration

MongoDB is chosen as the database technology for the project due to the following reasons:

- Flexibility: The NoSQL document-based architecture of MongoDB allows for flexible data handling. MongoDB does not need a predetermined schema, in contrast to conventional relational databases, making it simple to adapt and modify the data model as the project progresses. When working with dynamic and developing data structures, this flexibility is especially useful.

- Scalability: By distributing data across a number of servers or clusters, MongoDB is made to scale horizontally. The database can manage enormous amounts of data and high traffic loads more effectively because to this horizontal scaling feature. MongoDB can easily scale to meet the growing demands as the project matures and user demands rise.

- Performance: When it comes to data retrieval activities, MongoDB performs incredibly well. Its document-oriented paradigm and effective indexing techniques make data querying quick and effective. Complex queries with several fields and criteria are supported by MongoDB along with other query types. Furthermore, built-in caching and memory management tools boost query performance and speed up response times.

- Evolution of the Schema: MongoDB's adaptable schema makes it simple to handle alterations to the data structure over time. With MongoDB, changing the fields in a document may be done quickly and without messing up the data already present. In agile development contexts where needs may change often, this flexibility is very advantageous.
- Node.js integration: The official MongoDB driver for Node.js enables easy interaction with the project's Node.js backend. A wide range of functions and utilities are offered by the driver, which makes it easier to perform CRUD activities, execute sophisticated queries, and use MongoDB's cutting-edge features inside of Node.js applications.

5.4 Room Booking and Management

Since the project consisted of a web page and a mobile application, we needed to use a Puppeteer in Node.js provides a flexible and efficient solution for automating web browser actions. It assists us in creating a search room within the browser and retrieving the desired information. Also we use moment to get date of day.

5.5 Calendar and Appointment Scheduling

We use Syncfusion Flutter Calendar because of its wide range of capabilities, simplicity of use and flexibility . It enables us to easily add dynamic and practical calendars to their Flutter applications. Additionally, we used the provider to add an event to its internal state so that other widgets that depend on it might use it. Also we use flutter local notifications package to displaying notifications.

5.6 Meeting Feature

We utilize the Jitsi Meet library in our mobile application for the following reasons like Video meeting, security and privacy so in order to protect user data during video meeting, it provides end-to-end encryption and secure communication and finally we benefit give high-quality video meeting experiences via its strong architecture.

5.7 Search and Matching

The NPL was added so that users could easily search for other users by entering any sentence that contains the name of the person or any of their specific requirements. The NLP analyzes the sentence and provides results, such as "I want an expert who understands the Java language,"THE NLP is given All experts in the Java language, and not only that, the search feature is also available in the questions system that comes with the application, where the user can search for a question on a specific topic and view the comments on it. This is done by using a library in the backend called: natural, and we use the WordTokenizer with it in order to separate the sentence into words to understand and analyze them

5.8 Evaluation and Rating System

In order to make it easier for the student to choose the appropriate expert, and in order to support the expert's page, the application also provides an opportunity for the student to

evaluate the expert with whom he booked and received information from him, so the student can only evaluate the expert from 0 to 5 using stars, and he can also add a comment We used a library in the flutter that turns the number into a star, which is flutter-rating-bar

5.9 API Testing

We all know that we need to regularly test different parts of the server to see if the API is functional and what happens when we provide the required data. All of this is accomplished using Postman, a software development tool that enables the user to validate the request he intends to submit to the server. A specific web server address is used to send the request, after which the server's response is displayed.

5.10 Recommendation System

Based on the student's actions and concerns, we used the Recommendation system to make a number of specialists available to the student. Cosine similarity is a key component of the recommendation system, we also prepared the data using the TF.IDF.

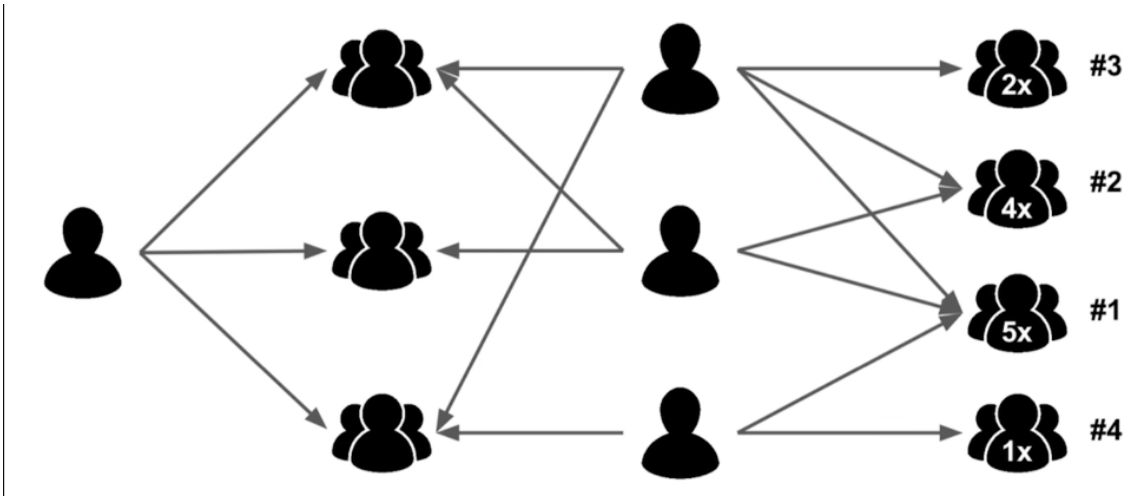


Figure 5.1: Server Design.

Chapter 6

Expert Recommendation System

6.1 Languages and Tools

We employed a variety of tools and languages to create our ML model. We utilized Flask, a Python-based web framework, for the back-end model. Flask gives you the resources and features you need to create Python web apps and APIs. Flask is a well-liked option for implementing machine learning into web apps, APIs, and other deployment scenarios because of its simplicity, versatility, and wide-ranging community support. It gives you the opportunity to take advantage of the Python machine learning ecosystem while supplying the required framework for creating scalable and effective ML-based applications. Our libraries in Flask were:

- pandas: This library offers capabilities for data analysis and data structures. It is frequently used for activities involving data analysis and manipulation, including loading data into data frames, processing the data, and arranging the data for later processing.
- Sklearn: This is the Python version of the scikit-learn library, a potent machine learning library. It offers a broad selection of machine learning algorithms, metrics, and preprocessing procedures.
- Re:Regular expression operations can be performed using this built-in Python function. It is employed in our code to clean up text by erasing special characters and digits from the text data.
- NLTK: The Natural Language Toolkit (NLTK) is a toolkit for activities involving the analysis of natural language. It offers a variety of resources and tools for jobs including tokenization, stemming, stop-word elimination, and more.
- Flask:is a web framework for creating Python online apps and APIs. To build a Flask application and construct routes (API endpoints) for processing HTTP requests, Flask is utilized in our code.

For development and code editing, we have used the following:

1. Visual Studio Code (VS Code):When developing and revising your Flask code, you did it in this integrated development environment (IDE). VS Code is a well-liked option for Python development because of its many features, extensions, and usability
2. Postman:Before using the mode, we trained the model and determined its accuracy using Postman, a popular tool for testing and documenting APIs.

3. MongoDB:It is the database that contains the data that we did the training on, and we passed this data using nodejs.

6.2 Dataset

The data set used in our project is based on data that is stored in the expert table's database. The model is concerned with the interest, even though the expert has a range of data saved, including name, email, interests, and so on. So that we could train the model, we added 70 experts to the data set.This is the count for each interest, as shown in the figure 6.1.

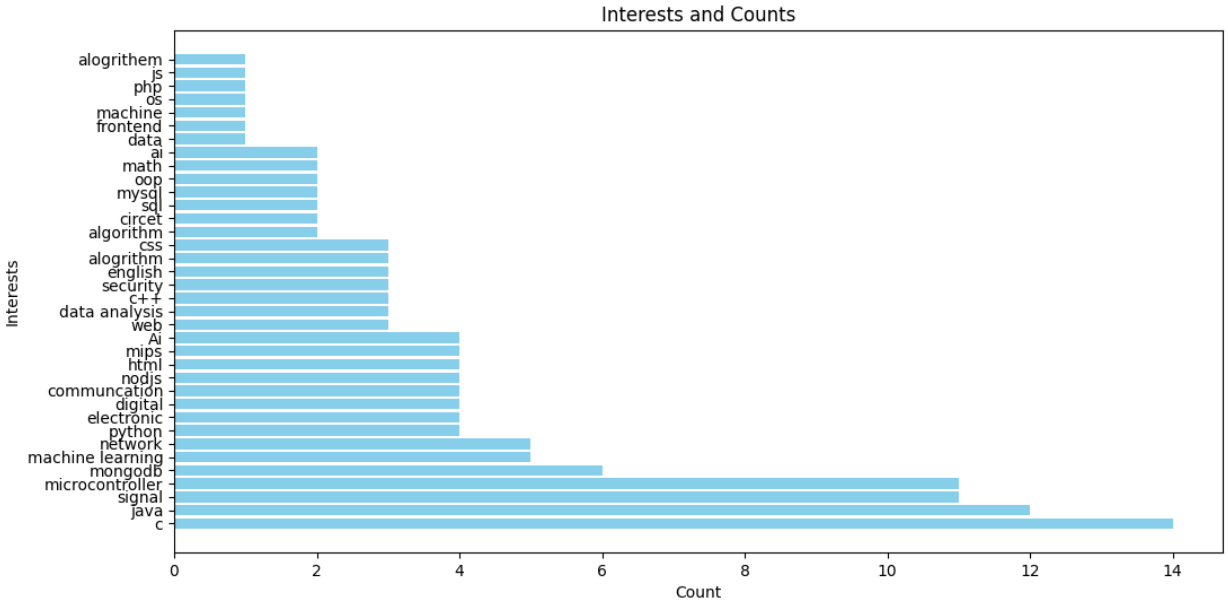


Figure 6.1: The Interest Count.

The model was trained on 70 records,and this is sample of the data :

Expert ID	Name	Interests
646f55d53994087567db8e40	Safaa	web, python
646f55ff3994087567db8e46	misam	data analysis, python
646f562f3994087567db8e4c	omar	machine learning, python, java
646f56423994087567db8e52	hytham	machine learning, c++, java
646f565a3994087567db8e58	ayham	c, java
646f56813994087567db8e5e	lubna	network, electronic
646f56923994087567db8e64	kamal	network, signal
646f56be3994087567db8e6a	soso	network, signal, digital
646f56ce3994087567db8e70	momo	network, digital
646f56e73994087567db8e76	ahmed	network, communcation
646f570e3994087567db8e7c	sophi	java, digital, data
646f57363994087567db8e82	doaa	c++, digital, algorithm
646f575f3994087567db8e88	samah	c, circet
646f57753994087567db8e8e	aya	c, circet, signal
646f578f3994087567db8e94	samah	c, signal
646f57b03994087567db8e9a	misam	java, frontend, nodjs
646f57c33994087567db8ea0	omar	java, web, mongodb
646f57e63994087567db8ea6	ansam	security, english, sql
646f57f73994087567db8eac	daya	security, web, sql

Figure 6.2: sample of the data.

6.3 Data Processing

Several procedures are carried out throughout the data processing phase to prepare the expert data and produce suggestions. Data cleansing, vectorization, and result visualization are some of these procedures. For the purpose of transforming and analyzing the expert data, each stage is essential.

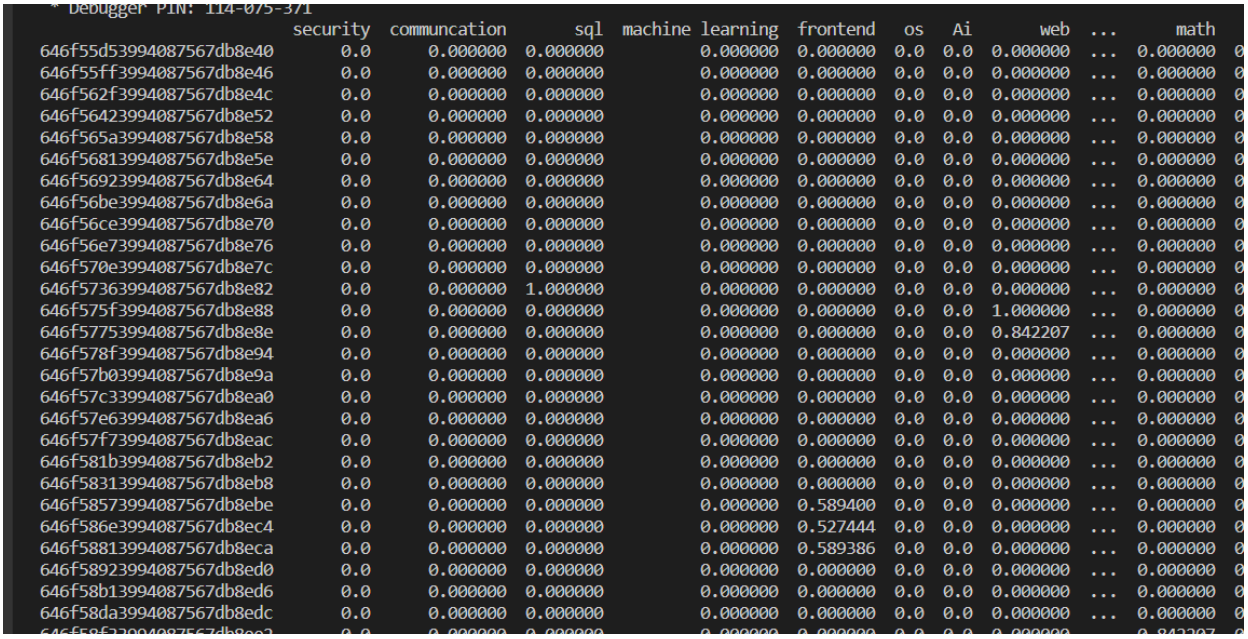
- **Data Cleaning:**Standardizing the text data and lowering noise are the goals of the data cleaning procedure. To eliminate special characters and numerals from the text, use the clean text function. Further modifications include changing the text's case to lowercase, tokenizing it into individual words, removing stop words, and using stemming to determine a word's root form. These actions add up to a clearer and more reliable representation of the expert interests.

- **Vectorization:** Vectorization converts the expert interests into a numerical representation that can be used for analysis. The `get_expert_vectors` function performs vectorization by creating a set of all unique interests across all experts. It then applies the `clean_text` function to preprocess the expert interests, generating cleaned texts. The TF-IDF (Term Frequency-Inverse Document Frequency) vectorizer from scikit-learn

is used to transform the cleaned texts into a TF-IDF matrix. This matrix reflects the importance of each interest within an expert's profile.

- **Result Visualization:** Visualizing the results aids in understanding the processed data and gaining insights. The `print_expert_data_table` function generates a table that displays the expert data, including their IDs, names, and interests. This table provides a clear overview of the expert profiles. Additionally, the `print_vectorized_table` function creates a table that showcases the vectorized representation of expert interests. This table presents the transformed representation of interests as numerical values, facilitating further analysis and interpretation.

The recommendation system can efficiently handle expert data, spot pertinent trends, and produce customized expert suggestions based on shared interests by conducting data cleansing, vectorization, and result visualization. Following the execution of TF-IDF:



	security	communcation	sql	machine learning	frontend	os	Ai	web	...	math	
646f55d53994087567db8e40	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	0.000000	...	0.000000	0
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646f562f3994087567db8e4c	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	0.000000	...	0.000000	0
646f56423994087567db8e52	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	0.000000	...	0.000000	0
646f565a3994087567db8e58	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	0.000000	...	0.000000	0
646f56813994087567db8e5e	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	0.000000	...	0.000000	0
646f56923994087567db8e64	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	0.000000	...	0.000000	0
646f56be3994087567db8e6a	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	0.000000	...	0.000000	0
646f56ce3994087567db8e70	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	0.000000	...	0.000000	0
646f56e73994087567db8e76	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	0.000000	...	0.000000	0
646f570e3994087567db8e7c	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	0.000000	...	0.000000	0
646f57363994087567db8e82	0.0	0.000000	1.000000	0.000000	0.000000	0.0	0.0	0.000000	...	0.000000	0
646f575f3994087567db8e88	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	1.000000	...	0.000000	0
646f57753994087567db8e8e	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	0.842207	...	0.000000	0
646f578f3994087567db8e94	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	0.000000	...	0.000000	0
646f57b03994087567db8e9a	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	0.000000	...	0.000000	0
646f57c33994087567db8ea0	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	0.000000	...	0.000000	0
646f57e63994087567db8ea6	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	0.000000	...	0.000000	0
646f57f73994087567db8eac	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	0.000000	...	0.000000	0
646f581b3994087567db8eb2	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	0.000000	...	0.000000	0
646f58313994087567db8eb8	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	0.000000	...	0.000000	0
646f58573994087567db8ebe	0.0	0.000000	0.000000	0.000000	0.589400	0.0	0.0	0.000000	...	0.000000	0
646f586e3994087567db8ec4	0.0	0.000000	0.000000	0.000000	0.527444	0.0	0.0	0.000000	...	0.000000	0
646f58813994087567db8eca	0.0	0.000000	0.000000	0.000000	0.589386	0.0	0.0	0.000000	...	0.000000	0
646f58923994087567db8ed0	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	0.000000	...	0.000000	0
646f58b13994087567db8ed6	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	0.000000	...	0.000000	0
646f58da3994087567db8edc	0.0	0.000000	0.000000	0.000000	0.000000	0.0	0.0	0.000000	...	0.000000	0

Figure 6.3: data after executing the TF$_IDF$.

6.4 Training Model

The training of the recommendation model involves the following steps:

- **Model Training:** The recommendation model is trained using the expert vectors and cosine similarity. This involves the following steps:
  - **Similarity Matrix:** The cosine similarity between expert vectors is calculated using the `cosine_similarity` function. This generates a similarity matrix that measures the pairwise similarity between experts based on their interests. The similarity matrix serves as a foundation for generating expert recommendations.
  - **Predicted Recommendations:** The `get_predicted_recommendations` function utilizes the similarity matrix to obtain the top-k recommended experts for a

given expert. The experts with the highest similarity scores are selected as the predicted recommendations. This process helps identify experts with similar interests to the target expert.

- **Performance Evaluation:** The NDCG (Normalized Discounted Cumulative Gain) statistic is employed to assess the effectiveness of the recommendation model. The NDCG is a ranking metric that assesses the quality of the recommendation list by taking into account both ranking position and relevance. It gives more points to the relevant experts at the top of the ranking. The model's capacity to produce high-quality recommendations can be evaluated by calculating the NDCG at a particular cutoff point (k). Better performance in terms of relevancy and ranking of the suggested experts is indicated by higher NDCG scores.

The recommendation model is trained using expert vectors and cosine similarity, and the performance of the model is assessed using the NDCG measure. The recommendation system can produce accurate and pertinent expert recommendations by following these stages, with higher NDCG scores indicating greater performance. Here is the accuracy ratio as in the figure:

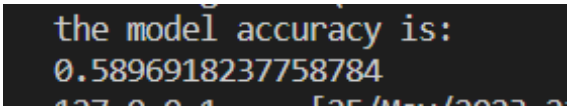

Figure 6.4: Model accuracy.

6.5 TF-IDF

It is common practice in information retrieval and natural language processing to quantify the significance of terms in a corpus of documents using the TF-IDF (Term Frequency-Inverse Document Frequency) technique. We employ TF-IDF in our recommendation system to convert expert interests into numerical representations that capture the distinctive features of each expert's interests. The TF-IDF process in our code involves the following steps:

- **Collecting Interests**: We start by collecting all unique interests from the expert data. These interests serve as the vocabulary for our TF-IDF transformation.
- **Cleaning Text**: To ensure consistent and accurate TF-IDF calculations, we clean the text data by removing special characters and digits. We also convert the text to lowercase to avoid any case sensitivity issues.
- **Tokenization**: The text is tokenized into individual words using the NLTK library. Tokenization helps in breaking down the text into meaningful units for further analysis.
- **Stopword Removal**: Stopwords, which are commonly occurring words with little semantic meaning (e.g., "and", "the", "is"), are removed from the tokenized words. This step helps to reduce noise in the data and focus on more meaningful terms.
- **Stemming**: We perform stemming using the Porter stemming algorithm from the NLTK library. Stemming reduces words to their base or root form, which helps in grouping similar terms together and improving the overall accuracy of TF-IDF.

Our recommendation model's use of TF-IDF enables it to assess and compare the interests of various experts with precision, enabling the precise identification of similar experts based on shared interests. The TF-IDF transition is essential for improving our recommendation system's precision and efficacy.

$$TF(t,d) = \frac{number\ of\ times\ t\ appears\ in\ d}{total\ number\ of\ terms\ in\ d}$$
$$IDF(t) = log\frac{N}{1+df}$$
$$TF-IDF(t,d) = TF(t,d) * IDF(t)$$

Figure 6.5: The TF-IDF equation.

6.6 Cosine Similarity

A popular metric for determining how similar two vectors are in a vector space is cosine similarity. In our recommendation system, we use cosine similarity to determine how similar the TF-IDF vectors of various experts are to one another. Based on their shared interests, this similarity metric aids in the identification and recommendation of similar specialists.

The cosine similarity process in our code involves the following steps:

- **Similarity Calculation**: Using the cosine similarity function from the sklearn.metrics.pairwise package, we determine the cosine similarity between the TF-IDF vectors of experts.Between -1 and 1, cosine similarity quantifies the cosine of the angle between two vectors. Vectors with a cosine similarity of 1 are said to be identical, whereas those with a cosine similarity of 0 are said to be completely opposite vectors.
- **Similarity Matrix**:A similarity matrix that stores the cosine similarity values produces a pairwise similarity score for each pair of experts. By ranking the similarity scores, this matrix enables us to find the experts who are most similar to a certain expert.
- **Top-k Recommendations**: We extract the top k experts for a particular expert who have the highest cosine similarity scores in order to make suggestions. These specialists are suggested as prospective collaborators or resources because they are thought to have the most comparable interests.

Our recommendation system can successfully find experts with related interests by using cosine similarity, and it can deliver precise recommendations. Based on the importance of their common phrases, the cosine similarity measure aids in capturing the semantic similarity between experts, facilitating fruitful partnerships and knowledge sharing.

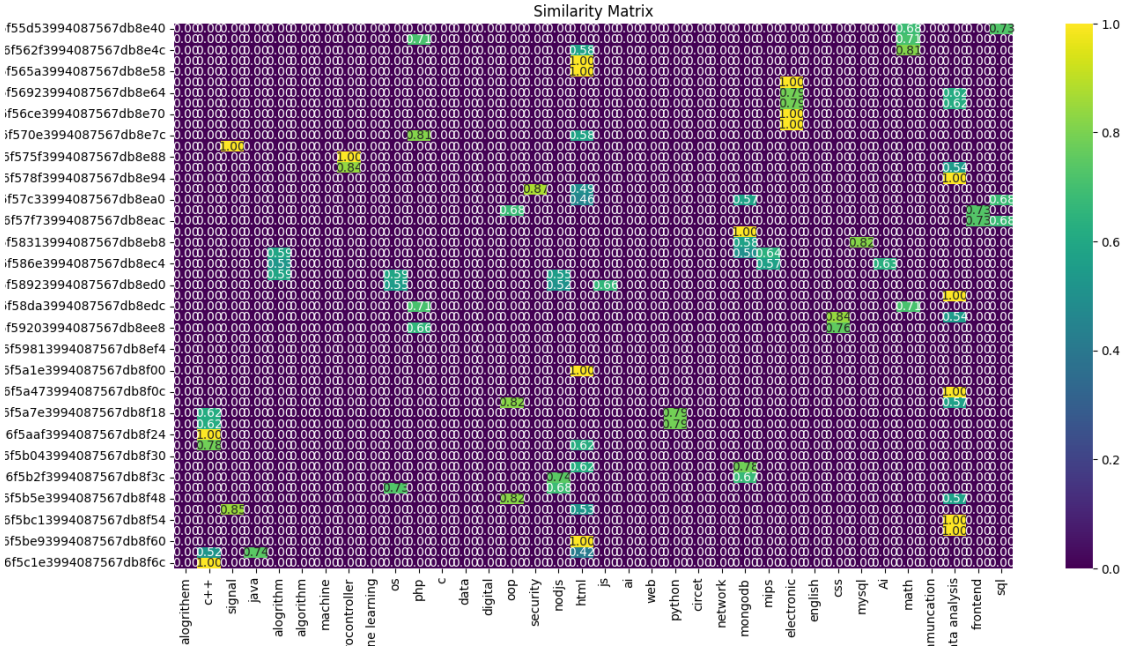

Figure 6.6: Training Accuracy Curve .

Chapter 7

Results and Discussions

CEE-Learning application is a cross-platform mobile application and website designed to cater to the needs of both students and experts. Its main purpose is to streamline communication between users and provide a platform for various related activities, Additionally, the application enables direct communication from students to experts, enhancing transparency and fostering trust between them. The application provides user account creation, allowing students to reserve appointments based on their preferences and ask questions related to various fields in Electrical and Computer Engineering. Experts can indicate their available free time slots. Additionally, all users have the ability to reserve any room in the Engineering College at An-Najah University.Furthermore, the application incorporates a robust communication system that allows users to engage in real-time messaging, chats, ask questions, or virtual meetings. This facilitates seamless interaction and enables users to exchange messages, participate in discussions, and seek guidance from expert Electrical and computer engineers. Additionally, we have developed an expert recommendation System which is a crucial part of our project since it enhances the academic support and guidance available to students studying electrical and computer engineering. The recommendation system works as an intelligent tool to help students identify the best subject matter experts, get individualized advice, and improve their overall learning experience. All of these endeavors have provided us with valuable experience and knowledge. However, it is important to acknowledge that achieving our goals was not without its fair share of challenges, difficulties, and the need to acquire new knowledge. This chapter will delve into the various obstacles we encountered and the lessons we learned along the way. Additionally, we possess an administrative page on our website, which is capable of displaying user information and facilitating the deletion of such data. Furthermore, the administrator has the ability to access a chart showcasing the earnings.

7.0.1 Learning

In order to acquire new knowledge and skills, thorough research is essential. It is crucial to ensure optimal utilization of the technologies involved, which requires effort and time, especially when dealing with unfamiliar technologies. For our project, we selected Flutter as our platform and leveraged various online resources to facilitate the learning process. Additionally, we opted for Node.js and familiarized ourselves with it through documentation and other relevant sources. Similarly, we learned how to work with MongoDB by referring to documentation and other available resources.

7.0.2 Challenges

- We encountered several challenges during the project, with one of the significant ones being the frequent updates to the software versions. This posed problems with compatibility between the code and the libraries used. It was crucial to ensure that the libraries were compatible with the specific software version being used. Consequently, we had to make necessary modifications to the code to align it with the corresponding software version.

- Understanding the causes of exceptions and errors in the code was not always straightforward. It involved investing time in research and troubleshooting to identify the root cause of the issue. Once the problem was identified, we would work on resolving it.

- Our project's recommendation system model development required overcoming a number of obstacles, including data availability and quality, scalability and performance, and system assessment and validation. To address these issues, careful data collecting, research into potential new user techniques, system scalability, and in-depth evaluations were necessary.

Chapter 8

Conclusion and Recommendations

8.1 Conclusion

The main goal of our project is to provide support to students in their studies related to Electrical and Computer Engineering. Through four months of continuous work, along with guidance and advice from our project supervisor, we successfully developed an application that enables direct communication between students and experts. Students can ask questions in any field of Electrical and Computer Engineering and receive responses from knowledgeable experts. They can also schedule appointments to receive assistance with course revisions or inquiries. On the other hand, experts can utilize their free time by offering appointments and earning income. Additionally, both students and experts have the option to reserve rooms in the engineering college at An-Najah University for various purposes, such as project discussions or addressing specific errors. Students can provide the expert with a description of their requirements or issues in advance, either during the booking process or through chat communication.
Building this application has allowed us to gain a wide range of skills:

- We have successfully created a mobile application and website using Flutter and the Dart programming language and Node.js. This has allowed us to leverage Flutter's extensive widget library and Dart's powerful features to build a robust and visually appealing app and make us familiar with Node.js.
- Throughout the project, we have collaborated with numerous Flutter packages to enhance the functionality of our app. These packages have provided us with ready-made solutions and features, saving us time and effort in development.
- We have successfully integrated our application with external API, including the Moodle API, to retrieve up-to-date information about the lecture schedules of rooms in the Engineering college at An-Najah University. This integration allows us to accurately represent the availability of rooms and provide users with information on when they can be accessed.
- We have successfully implemented a robust chatting system and meeting feature within our application, providing users with the ability to communicate and exchange messages in real-time to enhances user interaction Additionally, the meeting feature allows users to schedule and organize virtual meetings directly within the application. This enables students and experts to have face-to-face interactions, share screens, collaborate on projects, and address specific concerns or challenges.

- Our project's development of a recommendation system has greatly enhanced the academic support and guidance available to students studying Electrical and Computer Engineering. According to each student's unique interests and goals, the recommendation system effectively pairs them with the most qualified professionals. Through expert ratings and evaluations, it maintains quality assurance while making the process of getting help easier and improving user experience. The recommendation system, in its whole, fosters effective communication and the convenience of receiving academic support services, resulting in a fluid and productive learning environment.
- Dealing with developer APIs and using data from websites in our app. (1)
- In our app, we have worked with non-relational databases such as MongoDB and Firebase. This has provided us with valuable experience in handling and managing data in a flexible and scalable manner.

8.2 Recommendations

Mobile app development has emerged as a critical subject within computer science and engineering departments, warranting increased attention. Introducing a dedicated course that covers the fundamentals of app development would greatly benefit students, saving them valuable time and effort.

8.3 Future work

We don't want to just stop there, there are a lot of features that we want to enhance, and some that we want to add to our app.

- Chat system:We intend to improve it by adding voice messages, images.
- Enhanced Recommendation Algorithms: Exploring advanced recommendation algorithms, such as content-based filtering, collaborative filtering, and hybrid approaches, can enhance the accuracy and relevance of expert recommendations. Incorporating machine learning and deep learning models can also enable more personalized and precise recommendations.
- Integration of GPS for Face-to-Face Meetings: Incorporating GPS functionality can allow students to search for the nearest available experts for face-to-face meetings. This feature would enable students to have in-person discussions, consultations, or project collaborations with experts in their vicinity, promoting a more personalized and interactive learning experience.
- File Upload and Download Capability: The academic support platform may be improved by enabling users to upload and download books, lecture notes, and other learning resources. Students would be able to quickly access and distribute pertinent documents thanks to this feature, which would promote a cooperative and resourceful learning environment.
- The user can make a follow to the experts who have knowledge in the fields he needs.

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