

Yuxiao Yao. Development of an Administration System for a Social Networking Website. A Master's Paper for the M.S. in IS degree. April, 2020. 40 pages. Advisor: Ryan Shaw.

This project-based study develops an administration system for a social networking website that is designed for college students. The purpose of this project is to help with system management by administrators. To achieve the objective, the author analyzed user needs based on previous studies and comparisons with similar products, designed the system and developed the application based on the Django framework. Tests were performed to evaluate the system. Results show that the website works well and is helpful to target users.

Headings:

Web Development

Administration System

System Analysis

DEVELOPMENT OF AN ADMINISTRATION SYSTEM
FOR A SOCIAL NETWORKING WEBSITE

by
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A Master's paper submitted to the faculty
of the School of Information and Library Science
of the University of North Carolina at Chapel Hill
in partial fulfillment of the requirements
for the degree of Master of Science in
Information Science.

Chapel Hill, North Carolina

April 2020

Approved by

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1. Introduction

The recent emergence of social media sites proves their high usability and acceptability. It is not hard to find that social media has become one of the most important means of communication, especially for university students. The survey conducted from 2005 to 2019 by Pew Research Center [1] shows that young adults were among the earliest social media adopters and continue to use these sites at high levels. According to the report in February 2019, 90% of young adults aged 18-29 years reported regular use of at least one social media site. By education level, 79% of people who had at least college education reported the use of at least one social media site. However, concerns about social media such as cyberbullying, mental health issues, privacy, and security also have become hot topics and trouble a large number of users [2, 3].

Our project is aiming to build a social network for content sharing that connects students at the University of North Carolina-Chapel Hill. It has a relatively small scale to provide a more comfortable communication environment for students. With a sense of belonging and closeness of UNC students, the platform will break down the barrier between them. In this way, it can not only provide users with high-quality information related to their daily life, but also magnifies the benefits of diversity by collecting a variety of perspectives and feelings. The basic functions of the system are signing up, sending and editing posts, comments and likes, data analysis, user management and system management.

Students, staff and faculty are the main clients of the system. They are supposed to sign up and log in with their UNC email accounts to pass verification. Administrator accounts can only be added manually by the first level administrators. Students play important roles of both information providers and receivers in the system. However, without effective management and operation, the system cannot hold long.

This project was conducted by a team of two master students majoring in Information Science, Rui Hou and me. Rui was responsible for the user function, including registration, topic selection, sending posts search, etc. I was responsible for the administrator part, such as user information and content management, user data analysis tool, and authorization. Therefore, this paper will focus on backstage management by administrators. This part of the project is designed to achieve the following goals:

- 1) To enhance communication between users and administrators. Good functionality can be helpful to convey information between users and administrators. For example, administrators show rules of the platform and users can help to maintain the system by reporting bad behaviors or giving advice.

- 2) To be responsible for the content and detecting possible problems. We care about students' living and communication environment, so we need to maintain a safe and friendly environment for them on this platform. To prevent further problems, some mental health issues or legal issues should be paid more attention to.

- 3) To provide appropriate help and guidance. Helping users to enjoy communications here is the basic work of backstage managers. Sometimes guidance is needed to help students conduct certain activities on campus.

4) To let staff and faculty know more about students. Staff and faculty want to know more about students. Students' behavior data might help some departments do better in their jobs. As the user number goes large enough, the data collected by the platform represents students' thoughts to some extent.

5) To ensure data security and respect privacy. By authorization process, system managers give different roles different available functions in the system. Also, it is worth mentioning that backstage managers have different levels.

The steps of the project include:

- Gathering information: to collect data and analyze user needs.
- Planning: to decide on frames and relations between components.
- Design: to decide on page layouts and other details.
- Content writing: to prepare for communication with users.
- Coding: to develop the website.
- Testing and review: to do checks and fix problems.

This project adopts the lightweight unified process with agile development features as the software development method and uses the Unified Modeling Language (UML) as the analysis design description language. The main functions of the system are expressed intuitively by using the use cases, and then the activity diagram. The flow chart clearly expresses the flow of the functional logic of the functional module. Also, the project has a database template based on roles management. Due to the considerable number of people using the system, it is considered that the amount of traffic is quite comparable

during certain periods. This gives a strict requirement for systematic design. For example, if the homepage adopts the file format, every time you need to update the homepage, you need to establish a database connection and query the database. Imagine how the database can withstand the website site with such a large amount of traffic. It is easy to cause system servers and database servers to crash. At this point, the static page shows an unparalleled advantage, each access does not need to go through the database, server pressure has been reduced.

2. Background

2.1. User Needs Analysis

The population covered by the system are UNC students and UNC faculty and staff.

However, administrators are not limited to these roles, in fact, we encourage different roles to help with platform operation and management. Also, one person can have both a user account and an administrator account at the same time. As mentioned earlier, user accounts require UNC email verification while administrator accounts can only be signed up successfully with the permission of the superuser.

Computer system administrators are the highly specialized computer users of the system, working behind the scenes to configure, maintain, and troubleshoot the website to build a comfortable environment for clients. The system is comprised of dozens of components, for example, database management systems, web servers, application servers, and load balancers, and hundreds of servers that are distributed across multiple networks and operating system platforms. The complexity of managing these services is alarming in that a recent survey of three Internet sites showed that 51% of all failures are caused by operator errors [4]. However, not much can be found in the literature about the practices and problems due to a lack of in-depth studies of this critical user group.

Barrett [5] analyzed what system administrators do in terms of three important activities: rehearsal and planning, maintaining situation awareness, and managing multitasking,

interruptions and diversions. Automation can greatly ease human burdens, but also carries risks if it is not implemented well. Rehearsal and planning will become even more necessary in autonomic systems. Maintaining situation awareness means that the representation of the system to the user should be sufficiently complete for all normal operations while providing access to arbitrary degrees of detail in unusual situations. Handling multitasking, interruptions and diversions in autonomic computing operations means that interfaces must allow fluid movement throughout the system and maintain enough contextual clues so that administrators can easily shift between tasks.

How can we design more effective tools for system administrators? First, a common tendency is to sort work neatly into two categories, “knowledge” and “routine” work, and to automate the latter [6]. However, it is not easy because few activities can be neatly put into either one of these two categories. Multitasking and diversions even make the situation more complicated. At the same time, our project is not a highly complex system that leads to heavy workloads for administrators. Second, an important task will be to structure our understanding of these workers and their work in many different settings [7]. Our project focuses on the website within UNC, so that the number of active users would not be too large. The number of administrators and operation managers would be even smaller. Under such circumstances, it is not hard to find and analyze user needs using various methods including survey, interview, diary study and observations. The analytical tool should be designed even more carefully after understanding their needs and problems.

Meeting with them at different stages of the project before coding is important to make sure what we understand is close enough to what they want. Leading people to express their needs also need strategies [8]. At the end of the study, Barrett [9] summarized two main dangers during backstage design for system administrators. The first is that sysadmins already have many more tools than they can manage. A second danger is falling into the CLI (Command Line Interface) vs. GUI (Graphic User Interface) debate. To prevent these two dangers and other possible risks, we should fit system administrators' role into the whole system environment, and rethink about relationships between system managers and end-users.

2.2. Similar Product

In fact, there are some universities using their own social networks centered on the student experience and have a considerable number of active participants. MSOE Bridge, the school's own social network for students at Milwaukee School of Engineering. MSOE started with admissions because that was one of its areas of greatest concern at the start of the project, according to Dana Grennier, director of digital marketing at the school [10]. The community allows prospective students to connect with each other and communicate privately with their admissions counselors. Some current students also participate by acting as campus ambassadors. In 2013, MSOE developed a new version based on Jive Software's platform for social communities [11], which also have a broader mission to serve current students and alumni, as well as incoming students. Similarly, the University of Phoenix's Phoenix Connect [12], which claims a half-million registered members, 40% of whom are active participants every month, also based on Jive. Penn Foster offers a Jive-based social community to students in its online education programs (a mix of

college, job training and high school equivalency courses) [13]. However, Jive is not the only choice. Social Student is based on IBM Connections, which is also a broad-based social collaboration platform that includes tools for managing blogs and wikis in addition to discussion groups and social activity streams [14].

Social networks for university students are all over the world but have different content. U.K. based startup Unii, a student-only social network, signs up 100,000+ users in six months in the U.K. [15]. The social network is free for students to join and use, and won't ever be bothered by ads. Rather the plan is to launch a series of sub-businesses that sit on the platform and cater to students' needs — from the likes of finding accommodation (Unii Living), to buying and selling books, to finding a job (Unii Jobs) [16]. At Victoria University in Melbourne, Australia, the SNAP Platform is being designed to support the development of students' academic skills. It is based on the principles of wikinomics and incorporates Web 2.0 tools, communicative and collaborative potential between staff and students, the opportunity to discuss and share resources, peer engagement and mentoring, the creation of learning communities of practice and – at its core and as its acronym indicates – social networking for academic purposes [17].

From the perspective of the user population, we can divide these platforms into two categories: cross-university platforms and within-university platforms. Those platforms who have clients from different universities, try to connect students from different universities, or more generally, all young adults who want to share ideas with peers. They are more likely to have many users around the world and even become popular among

young adults. On the other hand, those platforms serve only one university can have additional customizations to fulfill various needs from different universities. Therefore, they are more likely to be sponsored by universities. From the perspective of content, those platforms can be divided into academic platforms and daily-life platforms. Studying is one of the most important topics at university, most of the academic platforms provide on-line resources for study and research, or tools connected to university offices and services. Daily-life platforms can have some more casual sharing and questions among students based on their interests. Of course, one website can have both academic and daily-life modules like Unii mentioned before.

Our platform is designed for students at UNC. Since there are several tools such as Sakai and Piazza, to support academic needs, we focus on students' daily life and entertainment such as "music" and "sports". We are purposefully locking down its user-base to make students more comfortable that they are sharing stuff only with each other, not with their parents and/or future employers. Verified identification also makes sure that it is a safer environment for sharing.

Workplace is another place that gathers people together. Actually, Enterprise Social Networks (ESNs) have been receiving increasingly more attention in academia and practice over the past years. Enterprise social networks are adopted by between 8% and 40% of companies [18]. According to Cao's analysis, both user's geo-location and position in corporate hierarchy are highly significant in predicting their interactions [19]. University students are highly related to both location and position. Most of the users live around campus and are equivalent peers.

The following figure from Wehner [20] depicts the definition of ESM in the context of Social Media (highlighted horizontally by a dotted line).

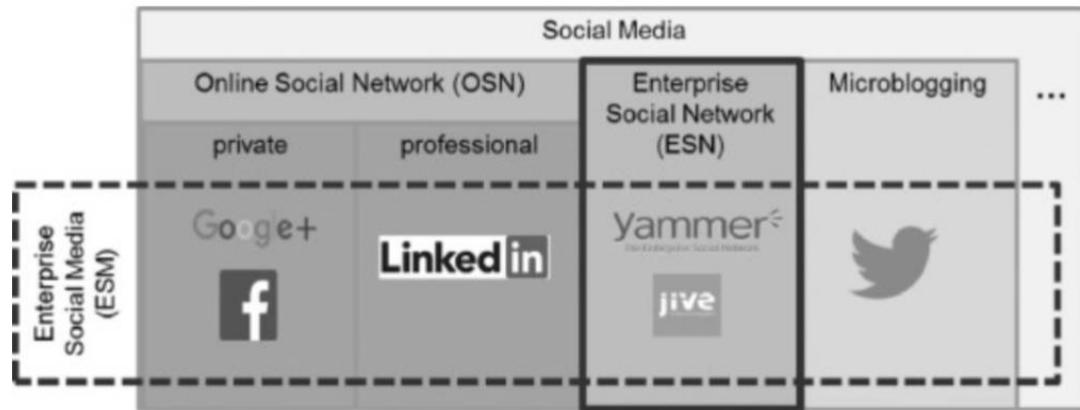


Figure 1: Social Media Products

We can see that there are already many similar products, from startups like Unii to popular platforms that served a lot of clients like Jive, from universities to enterprises. These platforms set good examples for us and they are not our competitors since our users are all within UNC.

2.3. Admin System Management

Except for students' communication, the system is aiming to help to build a good connection between faculty and students. Over the past 30 years, several management educators have urged faculty to reexamine their relationships with students. To do this, many have proposed novel metaphors to reconceptualize the faculty-to-student relationship. These include embracing students not as pupils to be taught but rather as clients, consumers, and even employees [21]. From the students' perspective, one may ask do students want more engaged relationships with their professors. DiVerniero's [22]

conclusion suggests that students desired “friendship” and similarity between themselves and their instructors. Also, the data revealed that students reported viewing their teachers' online profiles can help them understand who their instructors are outside of the classroom. Students do not see their professors as scholars holding higher status and deserving respect [23], but instead expect to have relationships with faculty that are social in nature, that is, friends or guides [24]. From the faculty's perspective, most tenure-track professors were trained in research universities where they were socialized to value research, scholarship, and expertise in their academic specialization [25].

Research and practice have mostly focused on the “bright side” of social media, aiming to understand and help in leveraging the manifold opportunities afforded by this technology. However, it is increasingly observable that social media present enormous risks for individuals, communities, firms, and even for society as a whole. Examples for this “dark side” of social media include cyberbullying, addictive use, trolling, online witch hunts, fake news, and privacy abuse [26]. It is observed that the relationship between the use of social media by people and loneliness and depression increases day by day [27]. Social media are always looking for ways to collect large amounts of accurate data about their users' online behavior to fuel targeted advertising efforts. This process often brings privacy concerns, as this information may not always be used as intended and is often mishandled [28]. Estimates of cyberbullying prevalence vary widely between studies and samples [29]. These concerns about cyberbullying, mental health issues, privacy and security show how the dark side of social media is threatening us and how people worried about those bad effects. Therefore, a safe and comfortable environment is very important to social media for university students. System operation managers need

to monitor and manage correctly, which is essential for running the system. System administrator is a person who is responsible for the upkeep, configuration, and reliable operation of computer systems. Operation managers for the system should keep an eye on the content users are posting and sharing, illegal statements should be deleted, and the user should be noticed. Under some special conditions like the intention of suicide or cyberbullying, we should pay more attention, and intervene in time to protect students if necessary. Another important role of system manager is that manage data generated every day. It includes user information, which might lead to privacy issues, and user behavior on this website. Interactive graphs will show statistics. Although a large amount of data is generated every day, the data is often heterogeneous. At the same time, social media is dynamic, the social information flow is continuously generated on the social network, which brings great challenges to the research and analysis of social data. Numerous studies have shown that human off-line behavior is highly correlated with the behaviors of online friends who are closely connected with them. A study based on cell phone records reveals the relationship between human movement and its social approach [30]. People tend to stay socially connected while changing their living environment [31]. These interesting findings can be very useful to know users. Our users' online behaviors help university departments make better decisions from various perspectives of education. Two or more generations will have more connections with the platform as a bridge.

Administrators may have different levels. The person who is at the top level may use all functions and change settings of the system. He/she can also assign rights to other managers at different levels. For example, some staff at UNC departments can view data

of users but cannot retrieve data directly from the database. Some people can delete inappropriate posts but cannot see user behavior analysis. The authority in the system mainly refers to the user's authority on a certain function. That is, users have different roles, so they see different pages from the system. End users never see system management pages. However, one person can have two roles, and one role will probably be played by more than one person. Since the system we are proposing is not a complex one, administrators might be UNC faculty or students, who are not required to have much technologic background. A straightforward user interface design is needed.

3. System Design

3.1 Functionality

3.1.1 Architecture

We used Django as our web framework. Django is a Python-based free and open-source web framework, which follows the model-template-view architectural pattern. Django is designed for easy and rapid development, which allows us to focus on writing the app without needing to reinvent the wheel. Figure 2 shows the architecture of our website.

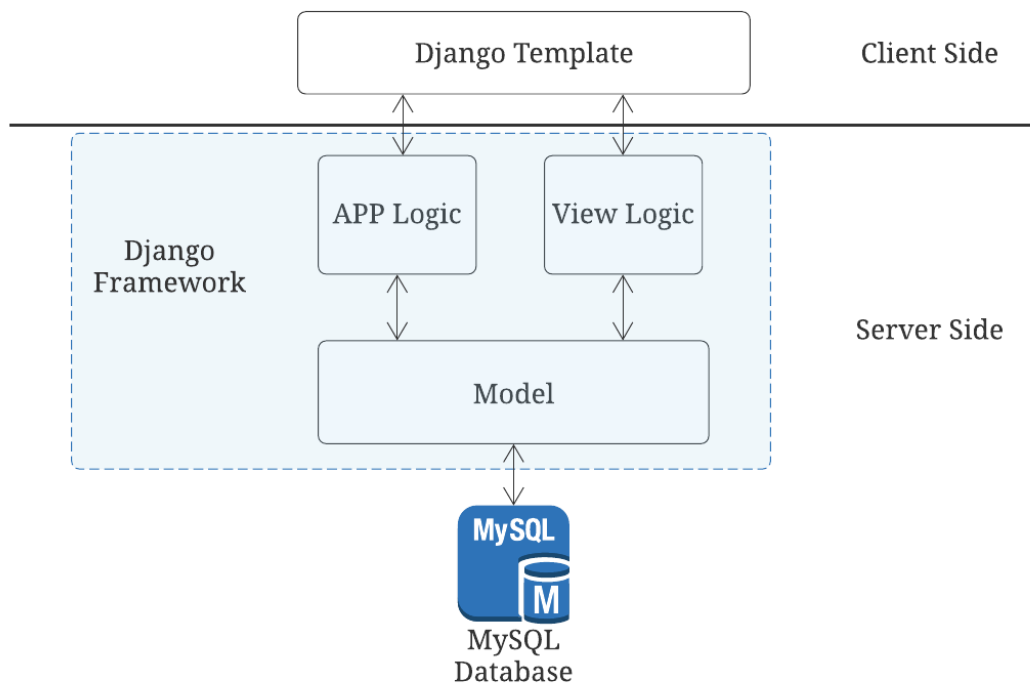


Figure 2: System Architecture

3.1.2 Function

Figure 3 shows the main functions of our platform.

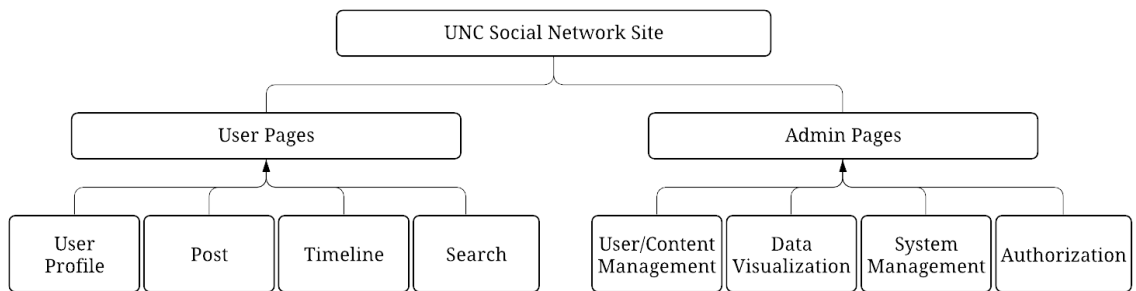


Figure 3: System Functions

1) Data Analysis Tool

Interactive graphs will display basic statistics like the total number of users, daily active users, page view and unique visitors of a certain page. Different data granularities can be chosen by users who have authorities to view the data. Users' actions will be recorded by event tracking. Event tracking is a common method to analyze user behavior. We plan to build a statistical code at key parts of the operation process to track each user's behavior and to quantify the extent to which critical processes are used. Also, we will embed multiple pieces of code in the product to track the user's continuous behavior, and a user model is built to show the user's behavior in using the product. Besides, we can optimize products through data analysis based on event tracking.

2) User Management

The management of user and content requires managers have access to databases of the system. However, a good user interface design will provide them with a more straightforward way rather than interact with databases. Operation managers may retrieve user's information and all posts and comment content. They can choose to enable or

disable a user or hide his/her posts and/or comments. Also, operation managers receive reports from end-users through message boxes within the website.

3) System Management

Some managers might be able to change system settings like website name, website introduction, website email address, system mailbox. The advanced settings include website root address, website file root directory, user file storage root directory, website default access authorization, whether users can set their default access authorization, whether to use simple cache, whether to use view cache, Whether to allow only login users to access, whether to use the protocol to handle user login, whether to open the website service.

Some spam may be generated during the running of the system. These data garbage cannot be used by the user, and the system will automatically clean up the data garbage. Administrators can set up a data spam cleanup cycle. The run log is automatically logged during system operation. The webmaster can set the log saving period and log deletion method.

4) Authorization Control

In our project, the end-user has access only to the front end of the system. Administrators at the higher level will be able to set authorizations to lower-level administrators. They can enable and disable basic functions and plugins for a user, including end-user and administrators, by assign roles to them.

3.2 Database

To store and interact with our data, we designed a relational database, from which data can be accessed or reassembled in many different ways without having to reorganize the database tables. We connected our site to the database using MySQL. For testing reasons, we imported example data by writing a script that loads data from CSV files.

For our project, we include basic information we need to support our functions such as signing up, posting and management. At the same time, it is designed for administrators to help them interact with data easily. For admin system design, database is even more important since both user/content management and data visualization heavily rely on the database.

We have six tables in total, including Users, Posts, Followings, Comments, Messages and Likes. Each of them has a unique identifier shown as the first column in this table, followed by related information. For example, in the Users table, we have user ID, username, email, gender, password, department, etc. In the Posts table, we have post ID, user ID, caption, post URL, date created and date updated.

The relationship and details about the database can be found in 4.2 ER Diagram.

3.3 User Interface

For admin pages, our user interfaces are designed to ensure that the elements are easy to access, understand, and use to facilitate functions we mentioned above. Before writing all functions, we designed the user interfaces for every page and developed a static template for all pages to extend. Based on four main functions for administrators, we designed a side-bar menu on the left of the page, including all functions we provided. Header and

footer areas provide searching, message center and user profile elements. On the right, we designed more space for information and settings. Both left bar and right bar can be expanded and collapsed. By default, the left bar is expanded and the right bar is collapsed. Figure 4 shows the basic static template used for every admin page.

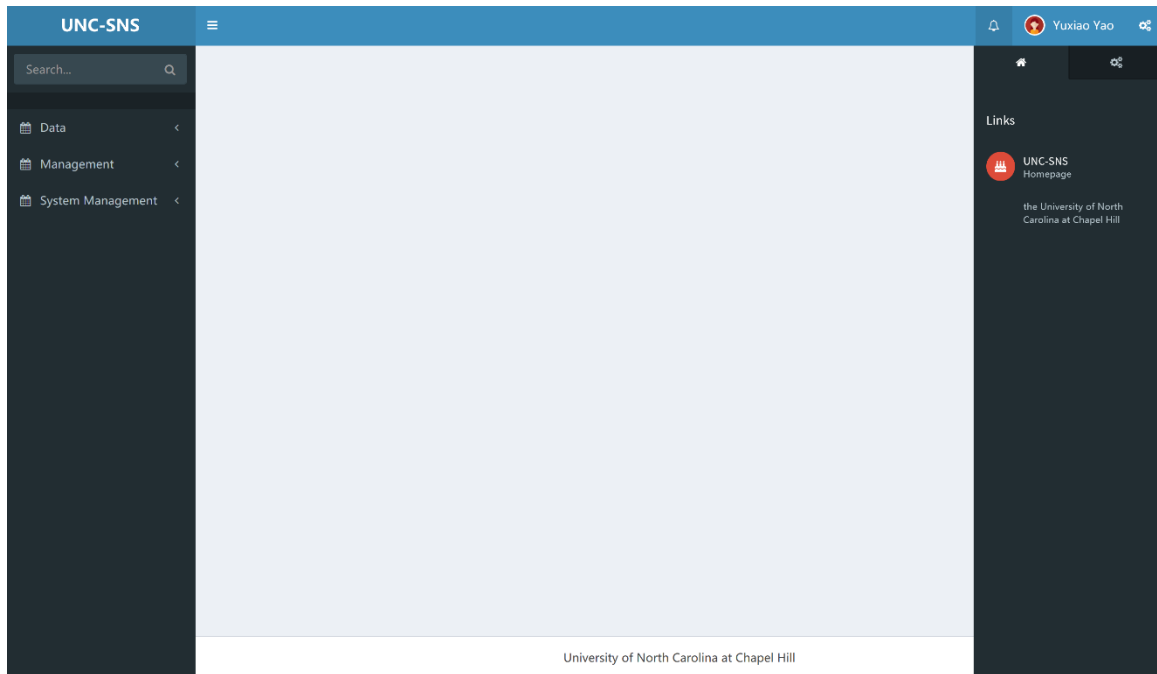


Figure 4: UI Template

Detailed user interfaces are shown in 5. Results.

4. Methodology

4.1 Data Flow Diagram

As data plays a very important role in system management and data visualization, we used data flow diagrams to represent the input and output process in the system. User information management needs both users and administrators to interact with data, and it is also a representative activity in our admin system. Figure 5 shows the data flow of related information. Some user actions might be simplified since this project focuses on admin pages. Figure 6 shows the data flow during the process of system admin maintenance. Figure 7 shows the data flow during the process of data visualization.

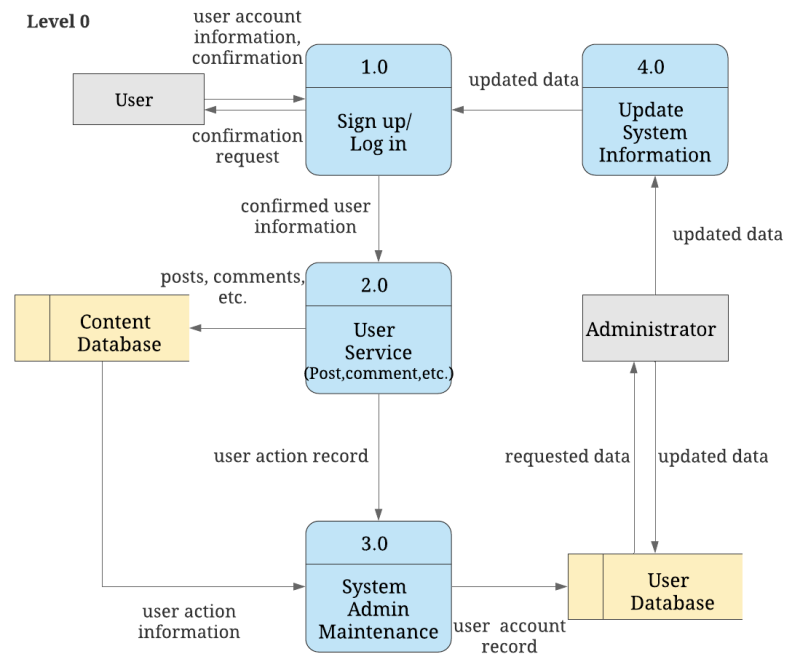


Figure 5: Data Flow Diagram of Admin System

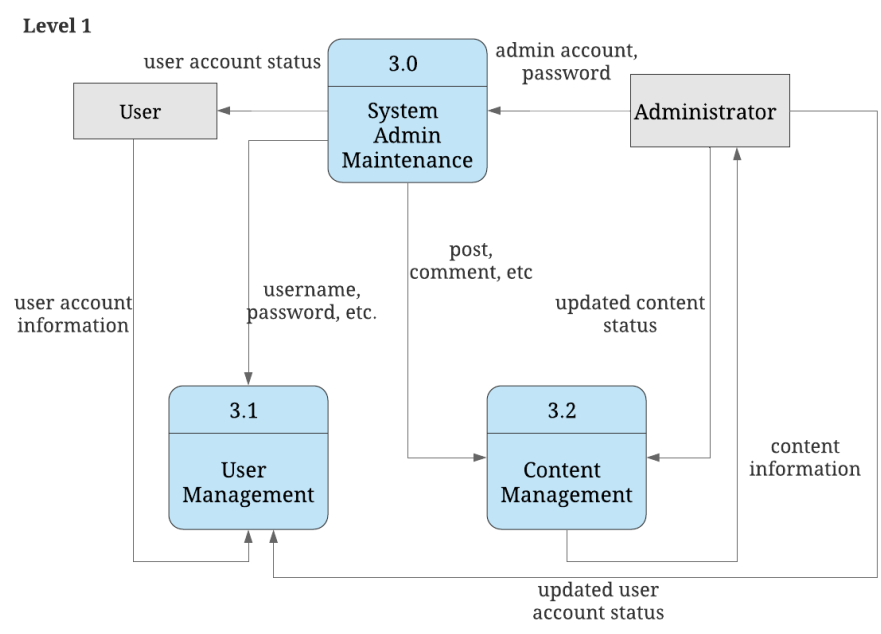


Figure 6: Data Flow Diagram of Admin Maintenance

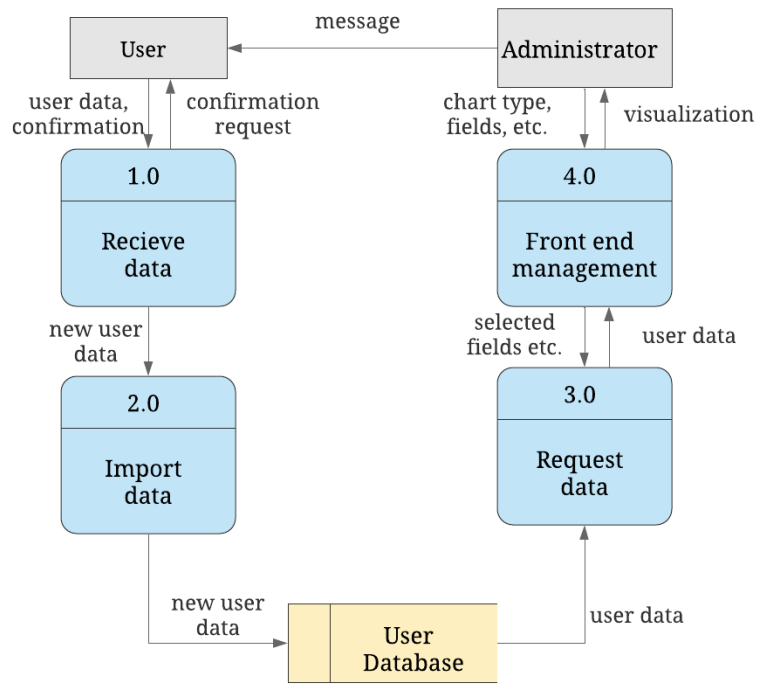


Figure 7: Data Flow Diagram of Data Visualization

4.2 ER Diagram

Entity Relationship Diagram, also known as ER Diagram or ER model, is a type of structural diagram for use in database design [32]. An ER Diagram contains different symbols and connectors that visualize two important information: The major entities within the system scope, and the interrelationships among these entities. To fully utilize the ER Diagram in database engineering guarantees us to produce high-quality database design to use in database creation, management, and maintenance.

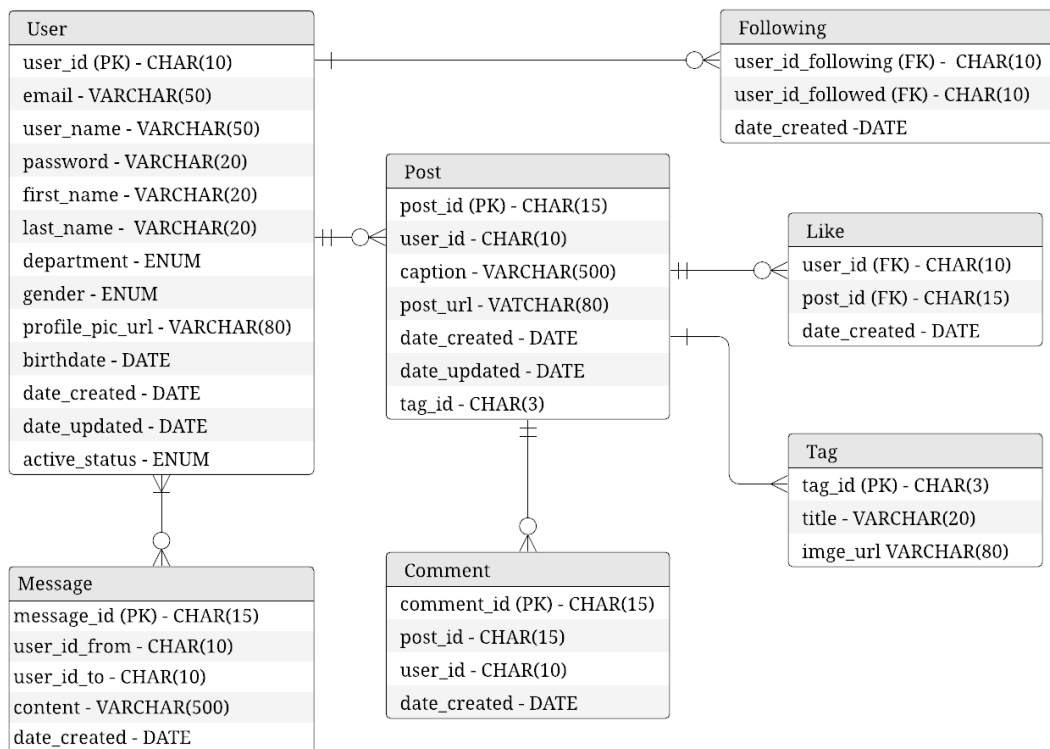


Figure 8: ER Diagram

4.3 UML Use Case Diagram

Unified Modeling Language (UML) is defined as a general-purpose, developmental, modeling language in the field of software engineering that is intended to provide a standard way to visualize the design of a system [33]. A use case diagram is a representation of a user's interaction with the system that shows the relationship between the user and the different use cases in which the user is involved. It has been said before that "Use case diagrams are the blueprints for your system"[34]. We used a UML Use Case Diagram to show how users and system administrators interact with the system.

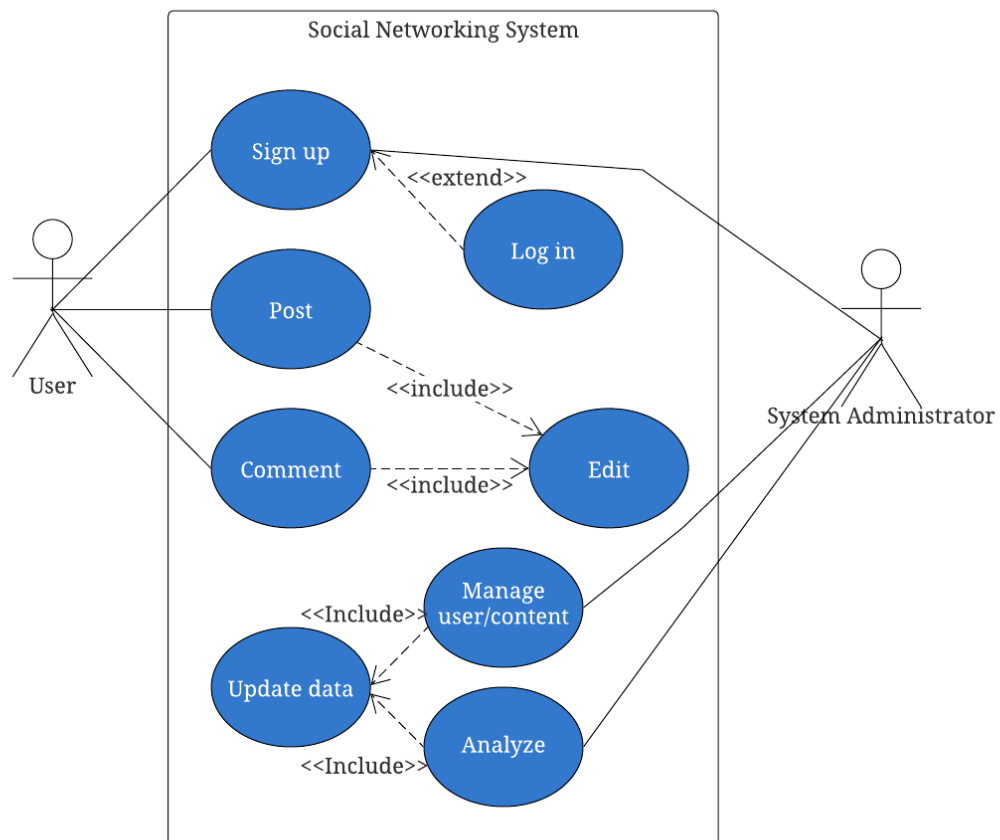


Figure 9: Use Case Diagram

4.4 Techniques

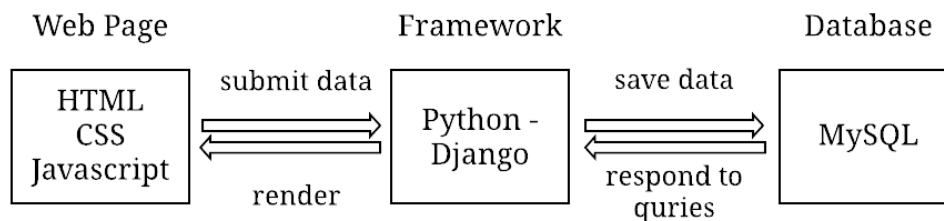


Figure 10: Techniques

Figure 10 shows the technology stack of the project.

For building a web page, HTML (Hypertext Markup Language), CSS (Cascading Style Sheets) and JavaScript are three basic languages that are always used together. HTML provides the basic structure of sites, which is enhanced and modified by other technologies like CSS and JavaScript. CSS is used to control presentation, formatting, and layout. JavaScript is used to control the behavior of different elements. we used these three popular languages for our project with the help of Bootstrap. Bootstrap is a framework to help you design websites faster and easier. It includes HTML and CSS based design templates for typography, forms, buttons, tables, navigation, modals, image carousels, etc.

As for web framework, we chose Django because of the following reasons: 1) It is a high-level framework that encourages rapid development and clean, pragmatic design. 2) It is written in Python, which is easy to use. 3) It supports MVC (Model-Template-View) programming paradigm. 4) Its automatic admin interface is very helpful for this project.

For database management system, we used a relational database due to its flexibility and standardization. MySQL is an open-source relational database management system (RDBMS). The database design can be found in 4.2 ER Diagram.

5. Results

In this section, system development results will be displayed in screenshots. Figure 11-15 shows the major pages of the admin system of the application. Based on system design, basic functions are developed in the demo application. Most of the pages are designed on the same user interface templates including header, footer sidebars. All pages can be accessed from the left sidebar.

Figure 11 shows the first page an admin will see after they log in to the system from the homepage. It includes important numbers and figures about website traffic and user demographics. The four numbers at the top of the page show the number of posts, number of page view, number of unique visitor and number of daily active users. According to user needs analysis, these are important numbers for administrators to monitor website traffic. Big font and thousands-separators make it clear and easy to read. Then several interactive figures show statistics page view, daily visit, weekly user with active levels, top development and major, gender and grade. They are divided into two sections with two collapsible boxes: visit analysis and user analysis, which administrators and data analysts care most for website data analysis. For visit analysis, line charts are shown by default. Administrators are able to switch the chart between line chart and bar chart according to their needs by clicking buttons at the top right corner. For all figures, we provided “see data in a table”, “update” and “save as image” functions, which can also be found in toolbox at the top right corner. With mouse putting on the chart, it will show

the exact number at that point as shown in Figure 1. All numbers are requested from the database and will be updated automatically every day based on system time.

In Page View, administrators can see the number of visits of different pages over the past half year monthly. Pages are chosen based on different topic sections, so that administrators can see trends of different topics such as music and sports, or total numbers. Daily Visit shows how the number of visits changes in a day. Peak periods are marked in red. Weekly User is displayed in a pie chart that presents the number and percentage of the number of unique users (IP addresses) and how active they are. Also, top departments and majors are shown in bar charts, gender and grade based on user profile are shown in pie charts.

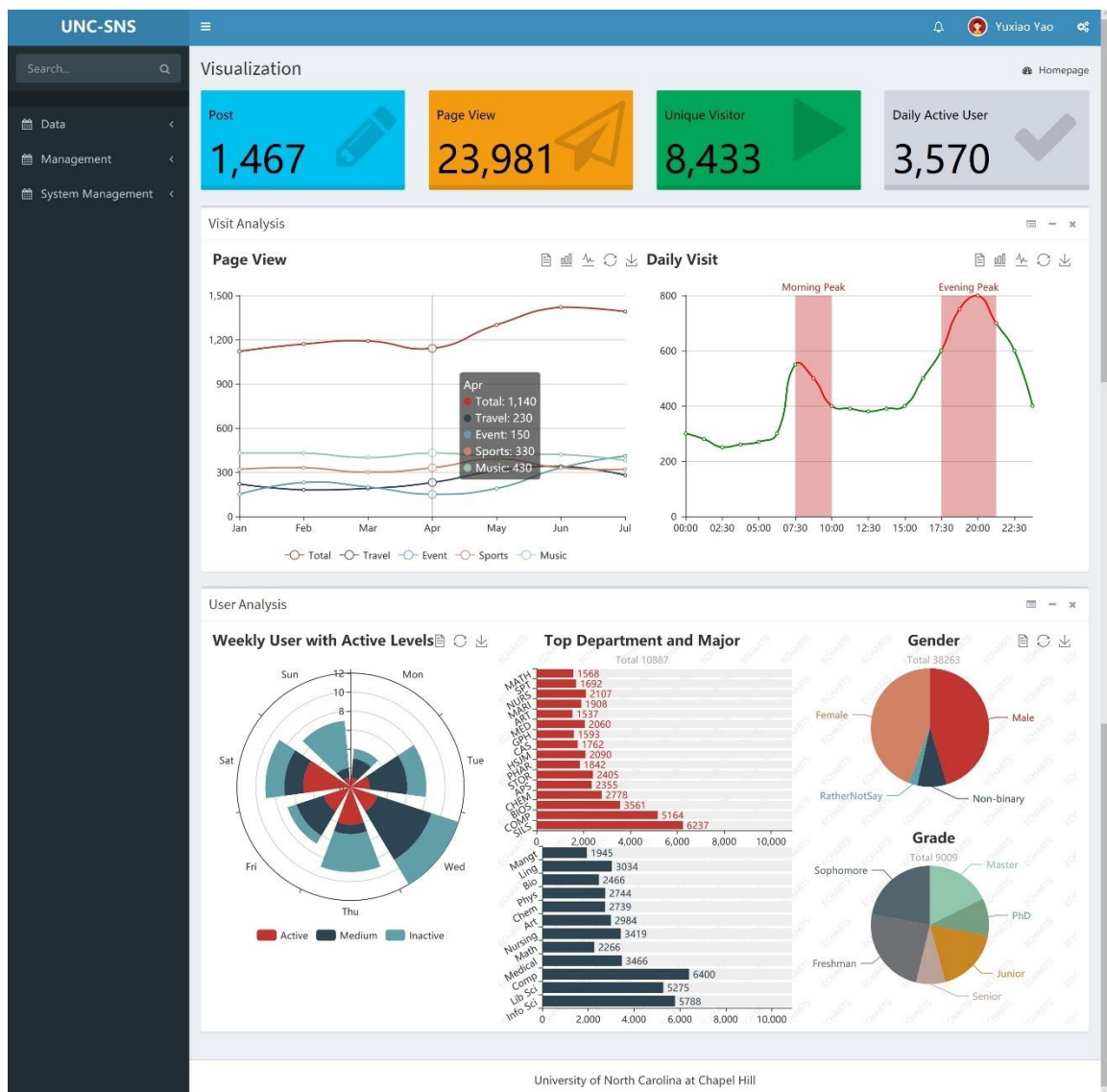


Figure 11: Screenshot of Data Visualization Page

We used Django administration system to achieve database management functions. After signing up for a new administrator account, users have access to Django administration system. When logging in, they can interact with the database by selecting certain records in a table, for example, User table and choose to delete them or update them. Adding a new record can be simply done by clicking the button at the top right corner. Detailed information of a user can be displayed and edited after clicking the username in the first

column as shown in Figure 14. There are four buttons at the bottom: delete, save and add another, save and continue editing and save. Also, administrators can check the history of editing.

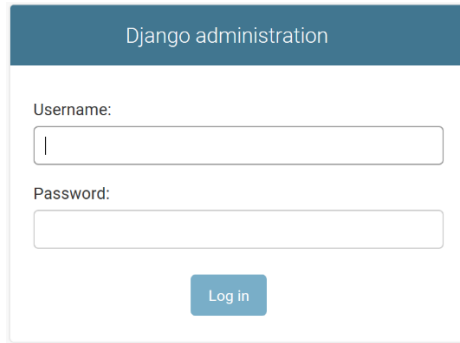


Figure 12: Screenshot of Log-in Page

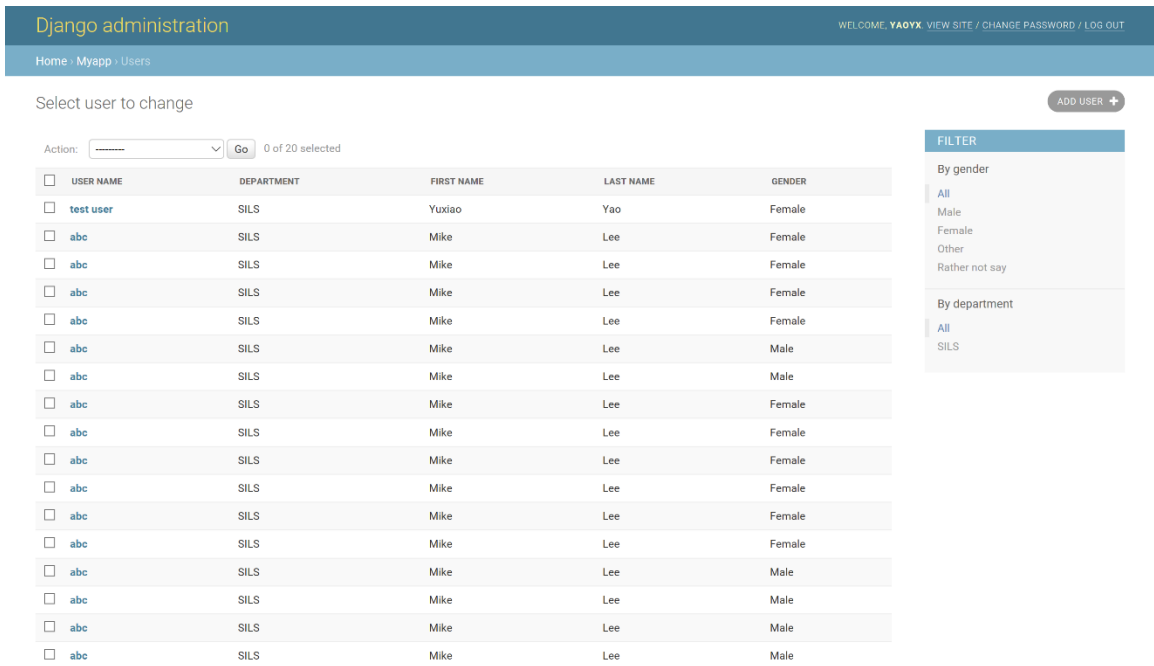


Figure 13: Screenshot of User Management Page

The screenshot shows the Django administration interface for editing a user. The page title is 'Django administration' and the breadcrumb trail is 'Home > Myapp > Users > test user'. The main heading is 'Change user' with a 'HISTORY' button. The form contains the following fields:

- User id: 123
- Email: yaoyx@live.unc.edu
- User name: test user
- Password: 123456
- First name: Yuxiao
- Last name: Yao
- Department: SILS
- Gender: Female (dropdown)
- Profile picture url: (empty)
- Birth date: 2020-01-01 (calendar icon) Today | Note: You are 4 hours behind server time.
- Active: (checkbox)
- Activation key: fehihefej

At the bottom, there are four buttons: 'Delete' (red), 'Save and add another', 'Save and continue editing', and 'SAVE'.

Figure 14: Screenshot of Detailed User Information

For system management, we provided system settings including configurations related to the system, and email settings to decide the email system for this website. In the demo, we provided basic functions such as title, bottom information, system URL for system settings and outgoing server and system email for email settings. More configurations will depend on the actual environment.

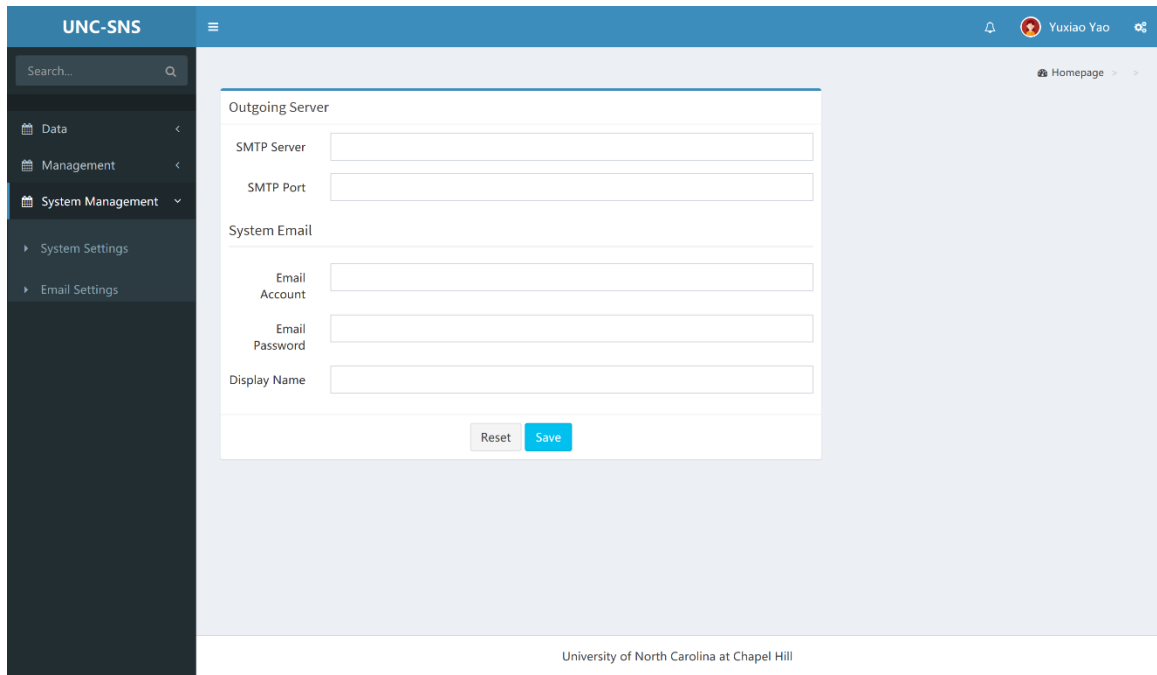


Figure 15: Screenshot of System Setting Page

6. Evaluation

6.1 Functionality: Black Box and White Box Testing

To test the functions of the system, we applied black-box testing and white-box testing. Black box testing approach is used to test the software without the knowledge of the internal structure of the application [35]. Meanwhile, white box testing, also known as structural testing, is a testing approach in which internal structure is known to the tester [36].

In black box testing, our goal is to verify input methods and outputs of the system without going through the code. we checked every function we designed to make sure that functions work well. Also, since invalid inputs may happen, we tried all different types of inputs including valid inputs and invalid inputs. After a few rounds of testing and debugging, the system provided functions as expected. For invalid inputs, the system provided prompt messages accordingly. Although black box testing is helpful for quick and easy test cases, it has restricted coverage since only a small portion of possible test scenarios can be performed on limited devices.

In white box testing, we examined the system more thoroughly by checking its inner structure. We used PyCharm as our integrated development environment (IDE), which helped me finding hidden bugs more efficiently. We went through the code and interacted directly with internal components. After debugging, it passed all tests and worked well.

6.2 Usability Testing Design

Usability testing is a necessary step before bringing the website to the real world. It helps testers to get real data on the user experience of our website, so that we can identify issues, sticking points, or deficiencies we may not have noticed. Although we do not have a chance to do usability thoroughly under this pandemic condition, we designed methods for usability testing.

For usability testing, our goal is to observe and analyze a person's behavior and how they interact with our website. Firstly, we need to choose participants who closely represent our target users. For our project, we would like to choose several staff members or students at UNC who are interested in or have experience with managing a website. Our target clients are relatively a small group of people within a small scale, so we choose moderated in-person usability tests, which happen right in front of me in a laboratory setting. In this way, we can observe their behavior clearly and ask their thoughts conveniently. The main methods include observations, surveys and interviews.

Here are steps of the usability testing process:

- 1) Preparation: prepare for the environment and testing materials, recruit participants.
- 2) Set up: introduce the purpose and background of the project.
- 3) Observation: start to observe participant's behavior such as action, eye-tracking and emotion and take notes. Encourage them to think out loud.
- 4) Problem discovery: test if users can complete certain tasks without running into any issues. Tasks include main functions and important pages.

5) Metrics: after finishing tasks, participants will be asked to answer questions in a survey related to their experience and feelings using a Likert's five-point-scale (strongly disagree, disagree, neutral, agree, strongly agree).

6) Interview: ask about their feelings, thoughts and suggestions. For example, ask them how they feel about the data visualization, which functions are good, and which can be improved.

7) Summary and conclusion: summarize survey results, interview records and notes. Draw results and improve the system.

If we change the system function a lot according to the first round of usability analysis, we will perform second-round testing. Some features may be difficult to decide due to participants' personal preferences, then A/B testing is a good way to provide more decision-support information.

7. Conclusion & Discussion

The project about social network site was designed for UNC students by Rui Hou and me. Rui is in charge of the user functions and the author focus on administrator functions. For this individual project, the author analyzed user needs based on previous studies and real-world situations, then researched similar products. The system was designed from perspectives of functionality, database and interfaces. With the help of important models, this paper presented relationships between different components within the system using diagrams. The demo application was developed and tested and showed good results.

However, there are still some limitations that can be improved:

- 1) Data analysis tools can have more interactive features. For example, administrators might want to choose a certain data granularity or period of time. The project can only show limited data and does not have many configuration tools.
- 2) Tests can be performed thoroughly. We did not finish usability tests due to the pandemic. Without feedback from target users, the system may have deficiencies we did not notice. Also, the functionality testing was only performed on a small scale and the system has not been connected to a server. The real performance for real-world data needs further tests. In the future, the author will connect the admin system with Rui's website and deploy our website to a server.

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