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AUTOMATION OF THE SYSTEM FOR INDUSTRIAL PRACTICE AND INTERNSHIPS FOR STUDENTS IN ORGANIZATIONS OUTSIDE OF THE UNIVERSITY

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Abstract: The organization of students' industrial practice during their studies is a key element in preparing specialists, especially in the IT sector, which requires a special approach. Universities usually collaborate with partner companies to create joint solutions, which involves providing material and educational resources, selecting qualified personnel, and exchanging experience. Despite the well-established work of universities and their partners, there are still many inconveniences and unresolved issues regarding coordination during industrial practice, such as determining the placement of students, coordinating the parties involved, and ensuring compliance with requirements, agreeing on criteria,

preparing necessary documents, and reporting. The biggest issue, however, is the lack of a unified digital automated platform, which forces all routine work to be done manually and requires passing through numerous administrative steps and approvals across different instances. **The purpose of the paper** is to investigate and develop an innovative system aimed at introducing digital document management and automating the process of organizing students' industrial practice using modern digital technologies. To enhance efficiency, contemporary technologies were applied, and optimization algorithms and models were developed to improve coordination and management of the process. The system being created meets high requirements for fault tolerance, security, and integration with current IT technologies, which contributes to improving the educational process and strengthening collaboration with partner organizations.

Key words: digitalization, automation, quality improvement, QoS, application, electronic document management.

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УНИВЕРСИТЕТТЕН ТЫС ҰЙЫМДАРДА СТУДЕНТТЕРДІҢ ӨНДІРІСТІК ПРАКТИКАСЫ МЕН ТАҒЫЛЫМДАМАСЫН АВТОМАТТАНДЫРУ ЖҮЙЕСІ

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Аннотация: Студенттердің оқу процесіндегі өндірістік тәжірибесін ұйымдастыру – мамандарды даярлаудың негізгі элементтерінің бірі болып

табылады, әсіресе IT саласы ерекше көзқарасты талап етеді. Әдетте, жоғары оқу орындары серіктес компаниялармен бірлескен шешімдер жасау үшін ынтымақтасады, бұл материалдық және білім беру ресурстарын ұсынуды, білікті мамандарды іріктеуді және тәжірибе алмасуды қамтиды. Жоғары оқу орындары мен олардың серіктестері арасындағы жүйелі жұмысына қарамастан, өндірістік тәжірибеден өту кезінде көптеген қолайсыздықтар мен шешілмеген үйлестіру мәселелері бар: білім алушыларға тәжірибе орнын белгілеу, тараптардың келісімі, талаптардың сәйкестігі, келісу критерийлері, қажетті құжаттарды рәсімдеу, есептілік және ең үлкен мәселе – бірыңғай цифрлық автоматтандырылған кеңістіктің болмауы. Бұл барлық рутиналық жұмысты қолмен орындауға және әртүрлі инстанциялардағы көптеген әкімшілік рәсімдерден өтуге мәжбүрлейді.

Осы жұмыстың мақсаты – студенттердің өндірістік тәжірибесін ұйымдастыру процесін цифрлық құжат айналымын енгізу және заманауи цифрлық технологияларды пайдалану арқылы автоматтандыруға бағытталған инновациялық жүйені зерттеу және әзірлеу. Тиімділікті арттыру үшін заманауи технологиялар қолданылып, процесті үйлестіру мен басқаруды жақсартуға бағытталған оңтайландыру алгоритмдері мен модельдері әзірленді. Жасалған жүйе жоғары сенімділік, қауіпсіздік талаптарына сәйкес келеді және заманауи IT-технологиялармен интеграциялануға қабілетті, бұл оқу процесінің тиімділігін арттыруға және серіктес ұйымдармен өзара әрекеттестікті күшейтуге ықпал етеді.

Түйін сөздер: цифрландыру, автоматтандыру, сапаны арттыру, қосымша, электрондық құжат айналымы, қауіпсіздік.

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АВТОМАТИЗАЦИЯ СИСТЕМЫ ДЛЯ ПРОИЗВОДСТВЕННОЙ ПРАКТИКИ И СТАЖИРОВКИ СТУДЕНТОВ В ОРГАНИЗАЦИЯХ ВНЕ ВУЗА

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Аннотация. Организация производственной практики студентов в процессе обучения является ключевым элементом подготовки специалистов, особенно сфера IT требует особый подход. Обычно вузы сотрудничают с компаниями-партнерами для создания совместных решений, что предполагает предоставление материальных и образовательных ресурсов, подбор квалифицированных кадров и обмен опытом. Несмотря на отлаженную работу вузов и их партнеров, существуют большое количество неудобств и нерешенных задач согласования при прохождении производственной практики: определение места обучающимся, согласование сторон, соответствие требований, критерии согласования, оформление необходимых документов, отчетность и самая большая проблема — отсутствие единого цифрового автоматизированного пространства, что вынуждает выполнять всю рутинную работу вручную и проходить через многочисленные административные этапы и согласования в различных инстанциях.

Целью данной работы является исследование и разработка инновационной системы, направленной на внедрение цифрового документооборота и автоматизацию процесса организации производственной практики студентов с использованием современных цифровых технологий. При реализации для повышения эффективности были применены современные технологии, а также разработаны оптимизационные алгоритмы и модели, направленные на улучшение координации и управления процессом. Создаваемая система соответствует высоким требованиям отказоустойчивости, безопасности и интеграции с актуальными IT-технологиями, что способствует повышению эффективности учебного процесса и усилению взаимодействия с организациями-партнерами.

Ключевые слова: цифровизация, автоматизация, повышение качества, приложение, электронный документооборот, безопасность.

Introduction. The interaction between students and employers and the active development of digital platforms for more efficient internship organization seems quite natural. Rapidly growing solutions in this area offer broad opportunities. One such direction today is the modernization and digitalization of business processes in education, which must meet the requirements for security, scalability, and fault tolerance of information systems, given the growing volume of information and

big data. One area that has not yet been fully realized in business processes is the digitalization of the student industrial practice process in various organizations, particularly for specialized fields. Workplace training is a crucial foundation for competency development during university studies, strengthening the connection between theoretical knowledge and real-world practice at enterprises. However, sometimes internships do not fully provide opportunities to develop practical skills, and the tasks assigned to interns are only indirectly related to their future profession, often involving routine, low-skilled operations. The success of an internship depends on many factors, one of which is finding a potential internship placement. Typically, universities provide students with a list of companies where they can complete their industrial practice, or the students find a placement independently. Both of these processes are done offline, taking up a lot of time for all three parties involved. The need for an information system that provides students with internship placement opportunities arises from the aforementioned issues, as well as several technical factors: the ability to process structured and unstructured big data, data protection, decision-making, document management, and the cost of services (Balakayeva, et al, 2022). Universities are obligated to take responsibility for organizing student internships in their own interest, ensuring a model of partnership between the university, students, and employers. The “connection of parties” through online platforms provides an opportunity for communication and interaction between these parties starting from the early stages of the internship, offering significant advantages. To enhance the efficiency of digital interaction between students and employers, there are many foreign analogs. There are a large number of such platforms, each with its own set of qualitative characteristics, advantages, and limitations. These systems are widely used in many countries, including the United States, European Union countries, and others. The issues related to adjusting the actions of managers of industrial practice, organizing internships, and communication platforms are discussed in (Daugherty, 2011). The problems related to finding and completing industrial practice by students are more broadly covered in (Alpert, et al, 2009).

Some of the most well-known platforms for student internships include Handshake, Riipen, Parker Dewey, and Virtual Internships. However, these solutions are not entirely suitable for domestic universities or have a number of drawbacks or compatibility issues with our conditions and laws. Another important reason for creating a custom platform is the internal labor market. For example, using external platforms might negatively impact the retention of young professionals. One such platform is Handshake, which is widely used in the United States to connect students with potential employers. It offers extensive opportunities for job and internship searches and is integrated with many university career services (TechCrunch). The Riipen platform specializes in experiential learning by integrating real-world projects into university courses. Employers post projects that students can work on as part of their coursework, gaining practical experience while studying (Faggiani, et al, 2018). Parker Dewey offers “micro-internships” — short-

term, paid professional assignments that help students gain valuable experience and build a work portfolio, while also allowing employers to complete specific tasks (TechCrunch). Virtual Internships provides remote internships in various fields and locations. It guarantees placement and offers flexible start dates and internship durations, making it accessible to a wide range of students, regardless of their location (Waddill, 2023). It is worth noting that in (Molodchik, et al, 2020), it was determined that platforms specialized in specific industries or fields are the most effective.

Despite the large number of internship platforms, there is still a shortage or even a lack of domestic solutions with similar functionality that could provide convenience for students, employers, and universities. Moreover, decentralized internship search, limited data analysis capabilities, and inefficient interaction among process participants remain key issues that could be addressed by implementing more effective, intelligent solutions capable of automating and optimizing the internship placement process. Such solutions could improve interaction between all participants and provide students with the quality experience necessary for a successful start in their profession. The absence of an electronic document management system may mean that participants need to perform more administrative tasks manually, which can slow down the process of signing and validating the necessary documents between students, companies, and universities. Furthermore, most existing internship organization solutions do not fully leverage modern technologies, such as artificial intelligence and machine learning, to automate the internship selection process and personalize recommendations for students, which we see as a potential development for the platform.

A brief review of the literature. Researchers emphasize that digitalization not only reduces time and administrative costs but also improves the organization of educational activities. According to the work of (Balakayeva, et al, 2023), automated systems allow for the optimization of tasks such as planning, reporting, documentation, and workflow coordination. Learning management systems (LMS) demonstrate high effectiveness in supporting students and instructors; however, they have limitations in the context of internship organization, where a more flexible approach to collaboration with external organizations is required.

Digital document management plays a central role in automating administrative processes. Research shows that the implementation of electronic documents significantly reduces processing time and costs, increases transparency, and enables real-time tracking (Balakayeva, et al, 2023). In the context of organizing internships, digital document management can ensure the efficient processing of contracts, applications, reports, and other mandatory documents, minimizing human error and the risk of information loss. Key technologies in this area include electronic signatures, automated document routing systems, and cloud solutions for data storage and access.

Platforms such as Handshake, Riipen, Parker Dewey, and Virtual Internships have already established themselves as tools for organizing internships and practical

programs for students. These platforms automate the processes of searching, coordinating, and completing tasks, connecting students with employers and providing them with hands-on experience. Research on the use of such platforms in the educational environment shows their high demand among students, particularly due to access to real-world tasks and the opportunity to work remotely. However, each platform has its limitations. For example, Handshake and Parker Dewey focus on short-term projects and primarily offer local opportunities, which limits their applicability for students seeking international experience. In contrast, Virtual Internships emphasizes remote work and offers a wide range of international internships, making it more versatile, though less accessible to universities with limited resources (Adler, et al, 2021).

The Beam.kz platform is focused on the domestic labor market of the Republic of Kazakhstan and currently collaborates with over 80 universities and more than 5,000 companies in the country. The platform does not have publicly available documentation online for viewing its document management system or workflows. However, demo versions are provided to educational institutions or corporate partners interested in the platform, allowing them to explore its integration capabilities with universities and companies (beam.kz, 2024)

Table 1 - Comparison of existing production practice platforms

	Beam.kz	Handshake	Riipen	Parker Dewey	Virtual Internships	JobTeaser
Location	Kazakhstan	USA, Canada, Europe	USA, Canada	USA	International	Europe, international
Users	university students, graduates, companies	students, employers, universities	students, teachers, companies	students, employers	students, employers	students, employers, universities
Partnerships	more than 80 universities and 5,000 companies in Kazakhstan	universities, employers	universities, colleges	universities	companies	universities, companies
the main purpose	job search/ internships, resume writing, career planning	search for internships, employment	project work with companies	short-term projects	virtual internships	career resources, vacancies
benefits for students	free access, resume creation, career fairs, job listings, digital career resources	access to vacancies, events	work experience in projects	flexibility, payment for projects	access to global internships	user-friendly interface, career resources

benefits for employers	access to the candidate database, simplified job posting, communication with educational institutions	direct access to students	quick access to talents	easy hiring for micro projects	access to international students	interaction with universities, branding
the application process	submission via the platform	profile and resume submission	registration, project selection	submission via the website	online submission	submission via your personal account
cost	free for students, possible subscription for employers	subscription for employers	variable tariffs	payment for projects	subscription for students and companies	the platform is paid for companies
Unique features	focus on the Kazakh market; joint activities with universities	built-in networking features	support for academic projects	payment for micro-tasks	fully virtual work	integration with educational programs
The main advantages	a local platform available free of charge for students; emphasis on cooperation with universities and companies in Kazakhstan	ease of use, student support	learning opportunities	low time costs	global reach	strong connection with universities
integration	-	university systems	learning platforms	-	-	university platforms
limitations	international accessibility; focused on the Kazakh market	not all employers can use	projects require curation	limited in time	fewer choice of employers	limited in the USA
electronic document management	-	-	-	partly	partly	-
technical solutions	web platform, mobile application	mobile applications, website	web application	web platform	virtual interfaces	web application, integration with universities

Despite the large number of practice platforms, there is still a lack or even lack of domestic solutions with similar functionality that could provide convenience to students, employers and universities. In addition, the decentralized search for internships, limited data analysis capabilities, and inefficient interaction of process participants are the main problems that can be solved by implementing more efficient, intelligent solutions that can automate and optimize the internship selection

process, improving interaction between all participants and providing students with the quality experience necessary for a successful start in the profession. Data security is also an important task (Mambetov, et al, 2022).

Modern optimization algorithms and artificial intelligence technologies are increasingly being used to improve efficiency. For example, (Uskinbaeva, et al, 2018) efficiently determine placement based on skills and qualifications, with the ability to match various requirements. The study highlights the potential of machine learning methods, which can be used to predict a student’s success at a particular company based on their academic and personal data. Such approaches contribute not only to the optimization of the process but also to increasing the satisfaction levels of both students and employers.

Despite the advantages of digitalization, significant barriers remain on the path to fully automating the internship organization process. One of the main issues is the lack of a unified digital platform that would connect educational institutions, companies, and students. In addition, many organizations face challenges in integrating digital solutions into existing educational management systems. Other critical aspects include data security and infrastructure reliability, especially in the case of international internships (Ma, et al, 2022).

Modern research shows that automation and digitalization of practice organization processes will develop along with the improvement of data processing technologies, artificial intelligence and cloud solutions. It is expected that the future of such systems will be associated with the creation of platforms capable of adapting to the needs of each participant — university, company and student. The introduction of a unified automated system for managing practices can significantly reduce the administrative burden and improve the quality of training in practice.

Methods and materials. Based on the identified needs, the system architecture was developed. The visual representation of the interaction between the main participants is as follows (Figure 1):

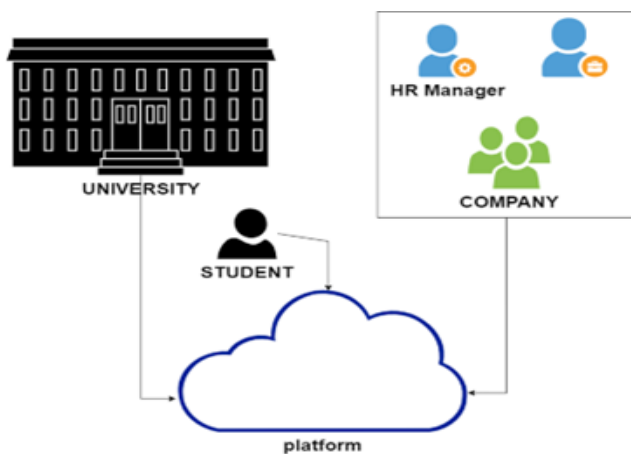


Figure 1. Presentation of the interaction “university - students - employers”

In the context of Queueing Theory (QT), the platform is considered as a request processing system. The platform must efficiently manage large volumes of requests, provide students with the necessary information in real-time, and track the status of documents, taking into account the system's processing speed and resource availability management (employers and universities). The model allows for predicting waiting times, minimizing bottlenecks, and improving the quality of service for all participants in the process. Since the processing time of requests can vary due to differences in approval processes, the classic $M/G/S$ model is applied, where M represents the exponential distribution of the time between request arrivals, G denotes the general distribution of service times, and S is the number of servers. The average number of requests entering the system per unit of time is defined as the request arrival rate, λ , and μ represents the service time for requests. The load factor ρ is then defined as

$$\rho = \frac{\lambda}{S * \mu} \quad (1)$$

where it shows how heavily the servers are loaded. If $\rho > 1$, it means that the system is overloaded. The average number of requests in the system is defined as:

$$L = L_q + \frac{\lambda}{\mu} \quad (2)$$

where L_q is the number of requests in the queue waiting for service, and is defined as:

$$L_q = \frac{P_0 \left(\frac{\lambda}{\mu}\right)^c * \frac{\lambda}{\mu}}{(S-1)! * (S\mu - \lambda)^2} \quad (3)$$

where P_0 is the probability of an idle server. W is the average waiting time in the system, which is expressed as follows:

$$W = \frac{L}{\lambda} \quad (4)$$

For a system with multiple servers and a database, the architecture can be represented with three main components: the client side, the server side, and the database.

The users, who are the subjects interacting with the system in the document flow space, are shown below in diagram (2-figure):

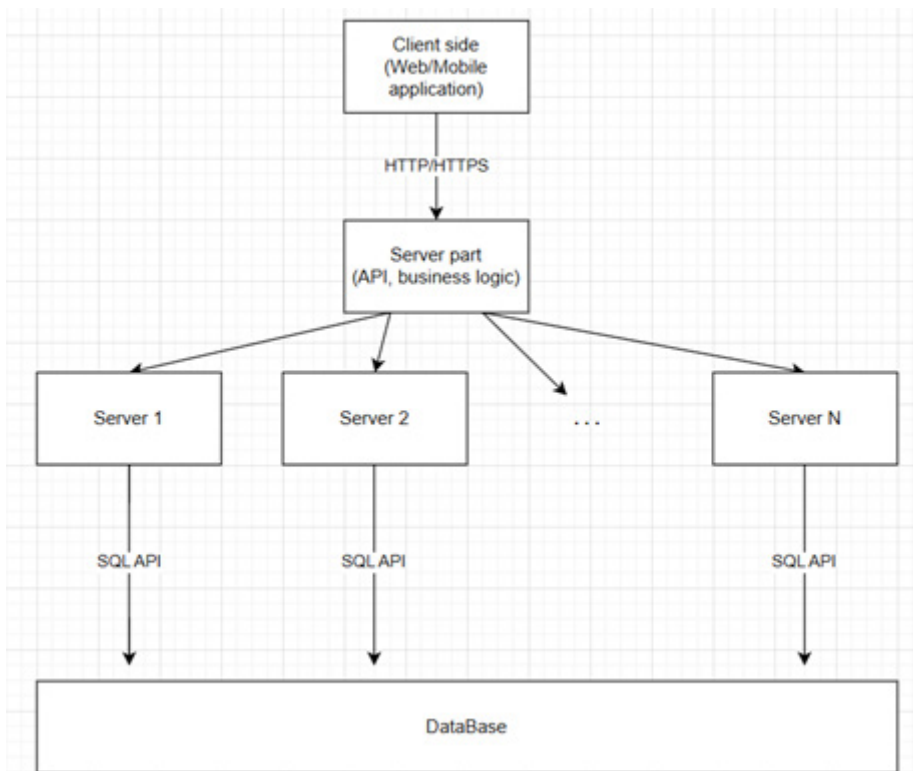


Figure 2. Client-server

The client side is the interface that users interact with: students, teachers, and companies. Users send requests to the server to submit applications, check the status of documents, sign reports, and so on.

The server side (API, business logic) processes client requests, manages application logic, processes data, and performs operations. It includes various services for handling incoming data and interacting with multiple servers and the database. The server side can be divided into multiple servers to distribute the load and improve fault tolerance. These servers perform different functions, such as processing applications, managing document flow, and logging. The server side hosts several physical or virtual servers that distribute the load and process data using a load balancer (Zhanuzakov, et al, 2024). The servers process requests from the client and interact with the database through an API.

The database (DB) stores all system data: information about users, applications, contracts, reports, and documents. The servers interact with the database via the SQL API for reading and writing data (saving reports, signed documents, application statuses). (Dayneko, et al, 2021). During the design, the experience of an educational resource with modeling was also considered of no small importance (Gubsky, et al, 2020). Systems design involves the determination of interdependent variables

and the precedence ordering for the tasks of determining these variables involves circuits. Circuits require planning decisions about how to iterate and where to use estimates. Conventional planning techniques, such as critical path, do not deal with these problems (Steward 1981).

The users who are entities and interact with the system within the document management space are shown in the diagram below (Figure 3).

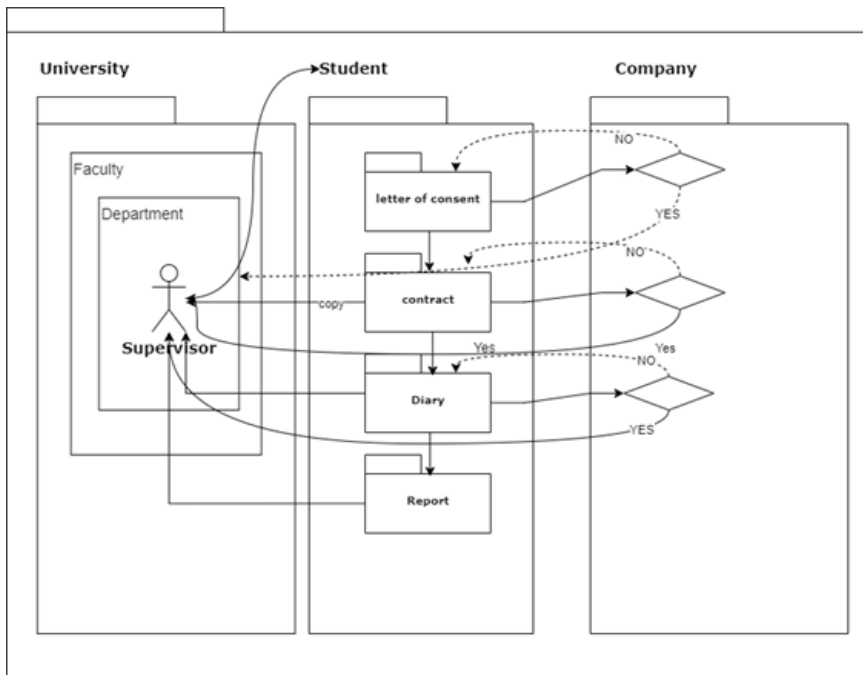


Figure 3. Diagram of the interaction of subjects with documents

Based on the identified requirements, the system architecture was developed, including several key modules:

1. **User Registration and Authentication Module** – ensures secure access for students, teachers, and employers.
2. **Document Management Module** – automates the processes of creating, processing, and storing documents, such as applications, reports, and contracts.
3. **Internship Search and Recommendation Module** – allows students to easily find suitable vacancies and provides employers with tools to post internship listings.
4. **Reporting and Analytics Module** – enables users to generate reports on internship progress and track statistics on performance and satisfaction.

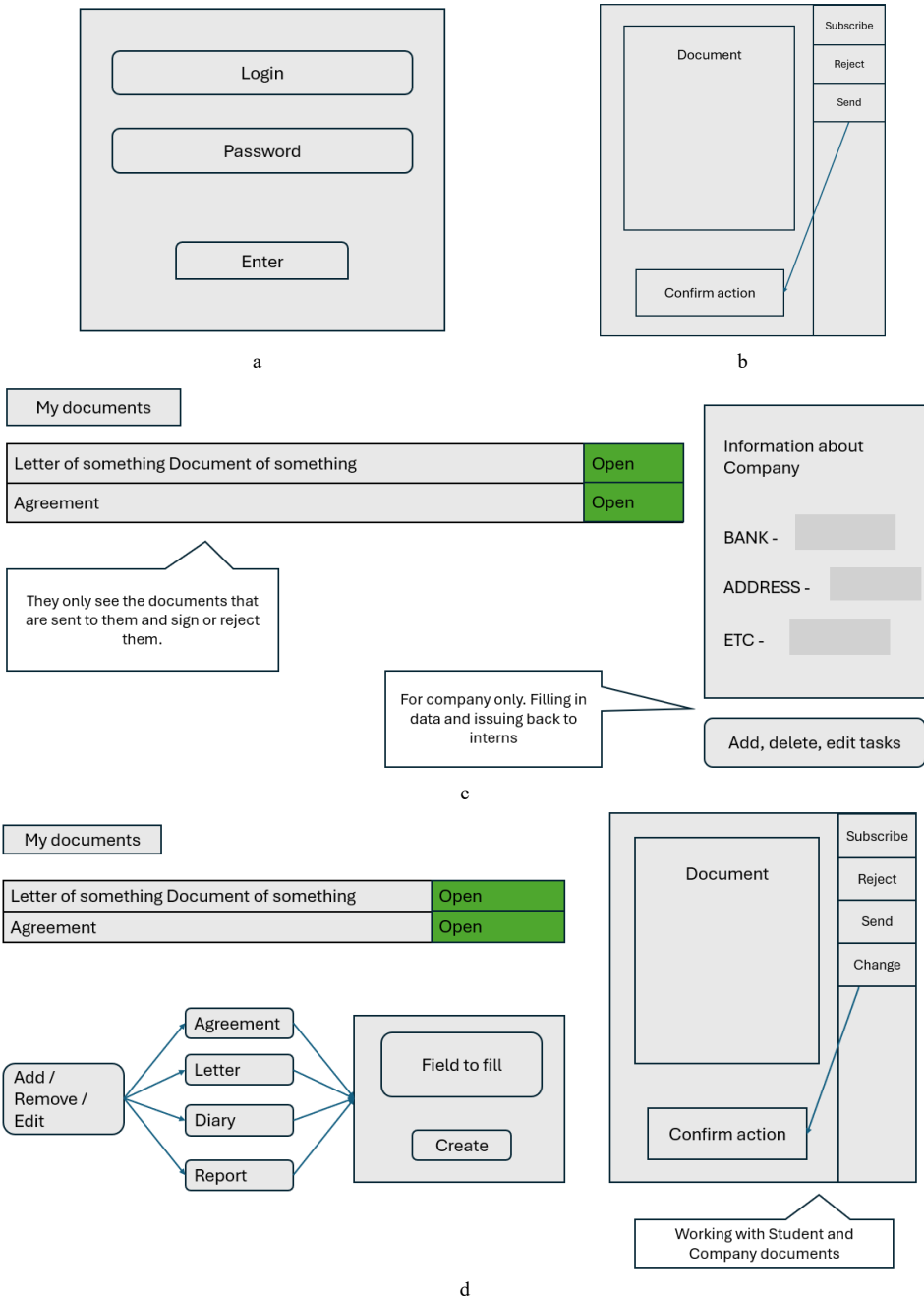


Figure 4. The modules of the system architecture

The interaction mechanism works as follows: the client side sends requests to the server, which processes these requests using business logic. The server side receives the request, analyzes it, and determines which operations need to be

performed (such as retrieving data from the database, executing an optimization algorithm, or sending a response back to the client). Servers handle operations in parallel if multiple servers are used, ensuring the system's fault tolerance. All data is stored in the database, managed through the SQL API, where information about users, documents, and applications is saved and updated. This architecture enables efficient processing and storage of information on applications, documents, and user interactions.

Results and Discussion. Based on the developed architecture and implemented modules, the document management automation system for organizing student internships has demonstrated significant improvements in document workflow optimization. The system has automated the process of creating, approving, and signing documents (such as contracts, diaries, and reports) between the university, the company, and the student. The use of the document management module will reduce the time required for document processing by 30–40%, also decreasing the number of errors and delays typical of manual processing. Thus, the platform will eliminate the need for in-person visits to various departments for document submission and approval, increasing convenience for users.

The system also aims to enhance interaction between students and employers through the internship search module, providing students with access to current vacancies and optimizing the process of choosing an internship location. Companies will be able to directly post their vacancies, receive responses from interested students, and track the status of documents. This significantly speeds up the internship matching process, enabling both parties to find each other more quickly.

Analytics and Reporting: The implementation of the reporting and analytics module has provided university administration and employers with the ability to track statistics on internship completion, student performance, and satisfaction with the program. This enables analysis of the effectiveness of partnerships and student satisfaction. As a result, the analytics data helps improve the quality of internship programs and allows for adjustments based on feedback.

Security and Fault Tolerance: The system was developed with security requirements in mind, including an authentication and access control mechanism. System testing demonstrated high fault tolerance: the architecture's resilience ensured uninterrupted operation even with a large number of users, increasing user trust in the platform.

Limitations and Areas for Improvement: However, testing also revealed some limitations. For instance, integration with existing university and company information systems is needed to further streamline document workflows. Future plans include adding features for more detailed tracking of student progress and a module for evaluating their skills during the internship.

Overall, the implementation results confirm the effectiveness of the proposed architecture, which not only simplifies document management but also improves the quality of interaction between universities, students, and employers.

Conclusion. The developed system for automating the student internship process has proven effective in managing document workflows, optimizing interactions between students, universities, and employers, and providing reliable analytics and reporting. Process automation significantly reduces document processing time, enhances convenience for students and companies, and improves the quality of interaction among participants. The implementation of a secure architecture and integration of modern technologies has helped create a flexible and fault-tolerant platform ready for future expansion.

However, there are opportunities for further improvement: integration with other information systems, expanded functionality for assessing students' skills, and enhanced mechanisms for tracking their progress. This work confirms that automating the internship process with digital technologies not only simplifies document management but also significantly enhances the quality of the educational process and interactions with partner organizations.

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