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TIME MANAGEMENT WEB -ORIENTED INFORMATION SYSTEM BASED ON THE MERN TECHNOLOGY STACK

The problem of fleeting time and its effective use has deep roots in human history. Many generations have asked the question of what time is, how it can be controlled, and if it cannot be controlled, how to deal with this enormous influence on human life. Time is the most valuable resource that you have to learn to manage. The more we manage to do, the better the quality of our work and life in general. And in the conditions of digital transformation and acceleration of changes, a clear order sometimes helps to maintain focus on goals, not to deviate from the course, and, ultimately, to be in demand in the labor market.

The main drivers of the time management system are management methods and techniques. Techniques allow different ways to compose a plan for different periods and evaluate priority. The methods, in turn, solve the issue of the implementation of this plan. The implementation tool is no less important, and here information systems have offered themselves very well. The possibility of dynamic planning, scalability, a system of reminders, and a system of rewards - all reflects powerful solutions for the introduction of time management.

This work offers an overview of the process of developing a convenient information system with time management methods. A study of time management methods was conducted. An information model was developed that combines Pomodoro techniques, ABC analysis based on the Eisenhower principle, and Getting Things Done. This model allows you to classify tasks according to the degree of importance, divide them into different groups and lists, assign time for long-term and short-term tasks, and analyze the degree of completion of each task and the work as a whole.

Modeling of the information system was carried out using the unified modeling language UML and its diagrams of precedents, deployment, classes, packages, and components, which simplify the creation of the application logic and reflect the structure of the application. The design of the system was also carried out using the creation of a prototype in the online vector service Figma. The information system is implemented as a client-server web-oriented application based on the MERN technology stack. React is used to develop the web application interface, Node.js, and the Express.js framework for the application server, which implements the creation and request of APIs for communicating with the document-oriented database management system MongoDB using the mongoose module.

Keywords: time management, client-server architecture, MERN technology stack, Eisenhower matrix, Pomodoro technique, ABC analysis technique

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ВЕБ-ОРІЄНТОВАНА ІНФОРМАЦІЙНА СИСТЕМА ТАЙМ-МЕНЕДЖМЕНТУ НА БАЗІ СТЕКУ ТЕХНОЛОГІЙ MERN

Проблема швидкоплинності часу та його ефективного використання має глибоке коріння в історії людства. Багато поколінь задається питанням що таке час, як його можна контролювати, а якщо його неможливо контролювати, як обходитися з цим величезним впливом на людське життя. Час – це найцінніший ресурс, з яким треба вчитися поводитися. Чим більше задуманого ми встигаємо зробити, тим краща якість нашої роботи та життя в цілому. А в умовах цифрової трансформації та прискорення змін, чітке розпорядження часом допомагає зберігати фокус на цілях, не відхилятися від курсу і, зрештою, бути затребуваним на ринку праці.

Головними рушіями системи тайм менеджменту є методи та техніки з управління. Техніки дозволяють різними шляхами компонувати план на різні періоди та оцінювати пріоритет. Методи в свою чергу вирішують питання виконання цього плану. Не менш важливим є інструмент реалізації, і тут дуже добре себе запропонували інформаційні системи. Можливість динамічного планування, масштабності, система нагадувань, система нагороджень – все це відображає потужні рішення для запровадження тайм менеджменту.

В даній роботі запропоновано огляд процесу розробки зручної інформаційної системи з методами тайм менеджменту. Проведено дослідження методів тайм менеджменту. Розроблена інформаційна модель, яка поєднує техніки Помодоро, ABC-аналізу на основі принципу Ейзенхауера, Getting Things Done. Дана модель дозволяє проводити класифікацію задач за ступенем важливості, розподіляти їх в різні групи та списки, призначати час виконання довгострокових та короткотермінових завдань, проводити аналіз ступеня виконання кожного завдання та роботи в цілому.

Проведено моделювання інформаційної системи уніфікованою мовою моделювання UML та її діаграм прецедентів, розгортання, класів, пакетів, компонентів, які спрощують створення логіки додатку та відображають структуру додатку. Також проведено проектування системи за допомогою створення прототипу у векторному онлайн сервісі Figma. Інформаційна система реалізована у вигляді клієнт-серверного веб-орієнтованого додатку на основі стеку технологій MERN. React використовується для розробки інтерфейсу веб-додатку, Node.js та фреймворк Express.js для сервера додатку, де реалізовані створення та запит API для комунікування з документо-орієнтованою системою управління базою даних MongoDB за допомогою модуля mongoose.

Ключові слова: тайм-менеджмент, клієнт-серверна архітектура, стек технологій MERN, матриця Ейзенхауера, техніка Pomodoro, методика ABC-аналізу

Introduction

Back in the days of ancient Rome, the famous thinker and statesman Lucius Annaeus Seneca reflected in his first of the «Moral Letters to Lucilius» on how not to waste time: «Time is the only and most valuable resource you

possess. Be strict with your time, know what you're spending it on, and appreciate when others give you their time.» Also, Seneca kept constant records of time in written form, just as he kept records of money [1].

A person's life and well-being are affected not only by a well-organized professional sphere, but also by the ability to self-organize. If there are opportunities that you don't want to lose, there is a need to realize your desire to have more and more space and responsibility for the ability to manage your plans.

Currently, the pandemic has provided even more free time. According to the Prometheus educational platform, during the pandemic, the number of active students of online courses increased 4 times, but the average rate of people completing the selected courses is only 13% [2, 3]. There are many reasons for this, but good time management can solve the issue of effectively managing your plans for any period and timely analysis of the already traveled path. Time management is a set of tools, methods, processes of rational, conscious control over the amount of time spent on a certain activity, aimed at increasing efficiency and productivity. The term expanded its meaning not only as control of work activities, but also of personal ones. Time management methods have reached various solutions for balancing goals related to family, hobbies, and self-development [4].

Time management allows you to solve various problems of human efficiency and work capacity: self-management, setting goals, focusing on the most important on a certain path, achieving results. Thanks to time management techniques, labor productivity increases, which in turn motivates to do better and achieve the maximum; responsiveness to relevant life challenges increases; it is possible to analyze the importance of mandatory or unnecessary questions [5].

Time management includes such actions as setting a goal, creating a plan, prioritizing, organizing work, decomposing as needed, delegating resources, monitoring and analyzing the path traveled, creating your own work system based on the analysis. The tool is suitable for creating various plans with different terms and substances. These plans can be divided into projects, detailed plans, or a simple list of tasks. In turn, these processes turn into a plan with a to-do list, schedule, calendar [6].

At the same time, time management has many human factors of the inability to correctly reproduce and the consequences of this inability - procrastination: a state when, in the process of work or study, any unexpected small message, not necessarily important, attracts all attention and concentration to itself and distracts from performing important tasks by switching away from unimportant ones, such as scrolling through the news feed, for example. This is solved by self-discipline, which in turn is a reward system or statistics of time spent on useless, unplanned actions [7].

Related works

There are a lot of applications that to some extent implement certain time management methods, for example, the implementation of the full Pomodoro method or the use of only the so-called time-boxing [8], but almost none of them implement time management comprehensively.

Web-based productivity, self-improvement, and habit-enhancing application with the ability to gamify processes and accomplish tasks while staying motivated and having fun at the same time, Habitica [9]. It has functions of to-do list management, task checklist, habit formation, functional Kanban board tracking, healthy and unhealthy habit analysis, which influence the reward system. Disadvantages include the complex appearance of the site, the inability to create your own groups of tasks, the gamification of the reward system can cause game addiction, conditional free, because full functionality can only be obtained through a paid plan.

A program for managing tasks to improve productivity Tweek [10]. This tool is built based on of a weekly calendar view without hourly planning, provides the ability to view weekly tasks, has checklists and subtasks, including recurring tasks, and is synchronized with Google Calendar. The disadvantages are the lack of ability to create lists of groups or folders, analysis of task performance.

MyLifeOrganized [11] is a task, project, and habit management tool designed to balance the simple with the complex. Once the data is loaded, the tool will create a simple list that contains only those actions that require immediate attention. The application has the functions of working with a to-do list, time tracking, mobile access, creating subtasks, but there is no calendar function, and as a drawback, it is worth mentioning the high monthly subscription fee.

Clear [12] is a simple to-do list app that allows you to cross off items on a list, but is only available on the iOS platform.

Purpose

An important factor in successfully mastering skills and using time management with the help of applications is the ease of use of the platform. This is influenced by the adaptability of the Web application and good UI/UX, ease of interaction with the functionality, cross-platform. In addition, for the psychological side of the issue, the ability to analyze usage in the form of statistics and a reward system is important, therefore the development of a convenient time management information system that combines basic time management techniques in its implementation is relevant.

Proposed technique

To implement time management, it is recommended to analyse of time use and planning for each equivalent period based on what has been done before this period and what is planned for the next. Such an opportunity is provided by the technique of prioritizing tasks for time management "ABCD analysis", or analysis according to the Eisenhower principle. According to legend, the matrix was invented by the 34th president of the USA, Dwight Eisenhower, and he used the matrix during his presidency. There was no official confirmation of this. In 1984, the matrix was first described by Lothar Seivert [13]. The technique is based on sorting categories of big data into groups, which uses the principles of importance and urgency [14] (Fig.1).

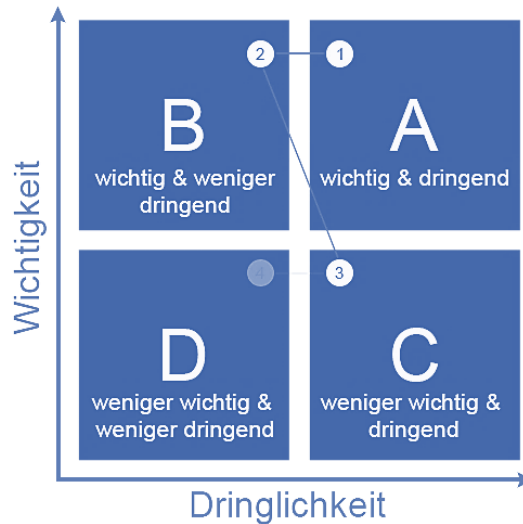


Fig.1. The Eisenhower matrix

Tasks are classified as follows:

- a) Type "A" - important and urgent, do not delegate to anyone and do as soon as possible;
- b) Type "B" - important and non-urgent, do not delegate to anyone, but set a deadline or delegate to subordinates and leave time for control;
- c) Type "C" - unimportant and urgent, must be delegated to subordinates if they do not need to have special knowledge and skills;
- d) Type "D" - unimportant and non-urgent, it is advised to abandon the tasks of this group altogether.

The technique of Brian Tracy, a specialist in self-development, is formulated as follows: "eat a frog for breakfast", where the frog is the most difficult task for a certain day, then the rest of the work will be completed almost effortlessly [7].

The Pareto technique [15] is a continuation of Brian Tracy's technique, which is useful when several task directions compete for attention. In the final step of the analysis of the profitability of each task, the one that will bring the overall benefit is chosen. This technique should be limited to the exclusion of important problems at the discretion of the performer, which at first glance and at a specific moment in time are not big, but have a claim to grow over time. This technique is more useful in combination with analytical tools, such as the analysis of the types and consequences of failures, which analyzes and identifies the most critical steps of production processes for the purpose of quality management, and the analysis of the "tree of failures", which with the help of graph edges and logical operators links element failures with object failures. Also, this technique is called the "80/20" rule, where only 20% of all cases provide 80% of the desired result.

The ABC-analysis technique is similar to the Pareto technique. Tasks are divided into three groups, according to their importance, which is based on three laws [16]:

- a) Type "A", or the most important cases, which are equal to 15% of the total number of all cases. These cases provide about 65% of the desired result;
- b) Type "B", or important tasks, which are equal to 20% of the total number of all cases. In turn, the significance of these cases is 20% of the desired result;
- c) Type "C", or unimportant tasks, which are equal to 65% of the total number of cases. Their contribution is 15% to overcome the goal.

It can be seen that the latter techniques involve a third-party solution to the importance of the task. In the case of the Eisenhower principle, at the stage of providing a classification for the "unimportant, urgent" group, it is necessary to additionally determine the degree of preparedness of the subordinate to whom the task will be delegated. The method of determining this argument is at the discretion of the user, which makes each existing case of using these techniques unique and subject to extensive analysis.

There is a combination of ABC-analysis with the Eisenhower principle (Fig. 2). It does not solve the fallibility of determining importance, but it reduces the amount of data for selection and analysis.

A	Important	AND	Urgent
B	Important	OR	Urgent
C	NON	Important	NON Urgent
D	Non-important	Non-urgent	Non-nessesary

Fig.2. Combination of ABC with the Eisenhower principle

It has the following three type groups:

- a) Type "A", or important and urgent. In a real case, no more than one or two such tasks per day. You need to solve such a task or tasks yourself with increased attention;
- b) Type "B", a task that is either important and non-urgent, or unimportant and urgent. In this type, the task owner must either make an artificial deadline to complete the task personally, or delegate to a subordinate and leave time for review;
- c) Type "C", a task that is not important for various non-business purposes and has an indefinite deadline. Such deliveries must be delegated to a subordinate.

You can ignore the option of type "D", which are unimportant and non-urgent, most often these tasks are not necessary for business purposes or work, but if they bring pleasure or recreation, then they can be kept.

A normal working day or the solution of business tasks should contain or should be performed first only those tasks that have the type "A" and "B", or "A", "B" and "C" [14].

The Pomodoro method is suitable for learning and work [17]. A 30-minute period of time is called a *tomato* - 25 minutes for work and 5 minutes for rest. In its simplest form, it works like this:

- make a list of tasks for the day based on your priorities;
- turn on the timer for 25 minutes, start working;
- after 25 minutes, take a break of 5-10 minutes (warm up or refresh the drink);
- after four tomatoes, take a long break for 15-20 minutes;
- continue to work for 25 minutes. After completing the task, cross it out and move on to the next one.

The Pomodoro method helps you get more done in less time. At the same time, workaholics also use it: they limit themselves in order to rest. When working on a timer, the user knows the value of his time, works more productively, manages expectations, trains willpower and prevents burnout. The timer is called "tomato" (Pomodoro) because Francesco Cirillo originally used a small kitchen timer in the shape of a tomato.

GTD, Getting Things Done, or the technique to make tasks get done, was created by David Allen [5]. The basic idea of the technique is to finish all the small tasks as soon as possible and break the big task into small ones. The reason for looking for this kind of solution was the warning of information overload, when the list of tasks becomes larger every day and is not solved so quickly. The practice of this technique is to put tasks and ideas on paper or not and organize them as quickly as possible so that it is easier to control them.

Results

A time management model has been developed that combines the GTD, Pomodoro and task list methods as follows: it is recommended to create a general task list and a daily task list, which consists of tasks from the general list for a given day. An alternative is to create lists of unimportant tasks. Tasks are prioritized as follows: they are numbered in the order of their importance and are done in this order, they are placed using a technique similar to the ABC method, where type "A" includes tasks for a day, type "B" for a week, type "C" for a month and method prioritization, where A-types include undesirable tasks (Pareto technique) when they are done, others are easier to do, and B-types and C-types can follow the same idea, but instead of necessarily doing exactly an unwanted task, avoiding it will motivate you to do all the other tasks to avoid it.

For the convenience of the user, an implementation in the form of a Web application using the Mern stack was chosen, the key components of which are:

1. MongoDB is a cross-platform, document-oriented database. Data is stored in flexible documents using a special query language based on JavaScript Object Notation.

2. Express. A basic platform designed for creating Web-applications. The platform is an original solution due to its minimalist structure and high speed of operation.

3. React is a JavaScript library designed for organizing user interfaces. The interface uses a functional programming language, not just templates. The main advantage is the execution of the code both in the browser and directly on the server.

4. Node.js is a cross-platform environment used to execute JavaScript. Built on the Chrome V8 JavaScript engine, the platform is used for scalable Web-applications.

The Mern technology stack is a full-stack development, that is, client-side, server-side and database development and the connection between them. The application has a three-level architecture model (Fig. 3).

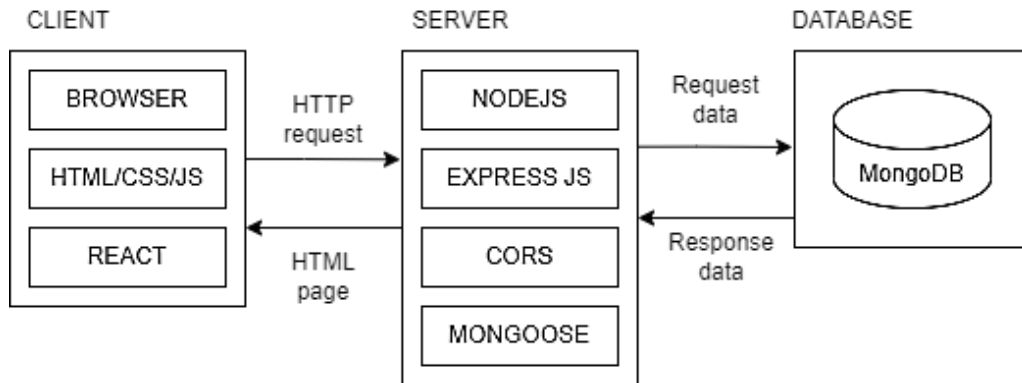


Fig.3. A three-tier application architecture model

The Web-server is the presentation layer and provides the user interface, content is developed using HTML, CSS and Javascript, React. The application server corresponds to the middle layer, which contains the business logic used to process user data. This layer is developed using Node.js and the Express.js framework. A database server is the data layer or server layer of a Web-application. It runs on database management software, in the case of this project and chosen stack, MongoDB. React is used to develop the Web-application's infrastructure, Node.js and the Express.js framework for the application server, which will implement the creation and request API for communicating with the document-oriented MongoDB database management system using the mongoose module.

The structure has a number of advantages, for example, it gives a lot of freedom to update or replace only certain parts of the program without affecting the product as a whole. This allows the application to be extended quite easily by separating the front end from the databases chosen according to the individual needs of the client, while at the same time critical components of the application can be encapsulated and preserved while the whole system continues to evolve organically.

For the developed system, deployment diagrams were constructed to visualize the topology of the physical components of the system and component diagrams to model the physical aspects of the system (Fig.4.). Component diagrams are used to describe components, while deployment diagrams show how they will be deployed in hardware.

The deployment diagram represents the three components of the hardware topology of the system: the client-side server, the Web-server, and the database (Fig.4,a). The component diagram of this project (Fig. 4,b) depicts the client side with the React.js program, the server side with Node.js and the database. React.js is based on a Single Page Application (SPA), and this avoids loading a new page with each action and greatly simplifies the user experience.

The following functions were defined for the system:

- creating a user;
- creation of groups;
- task creation;
- task review;
- assignment of eigenvalues for the Pomodoro timer;
- analysis of statistics.

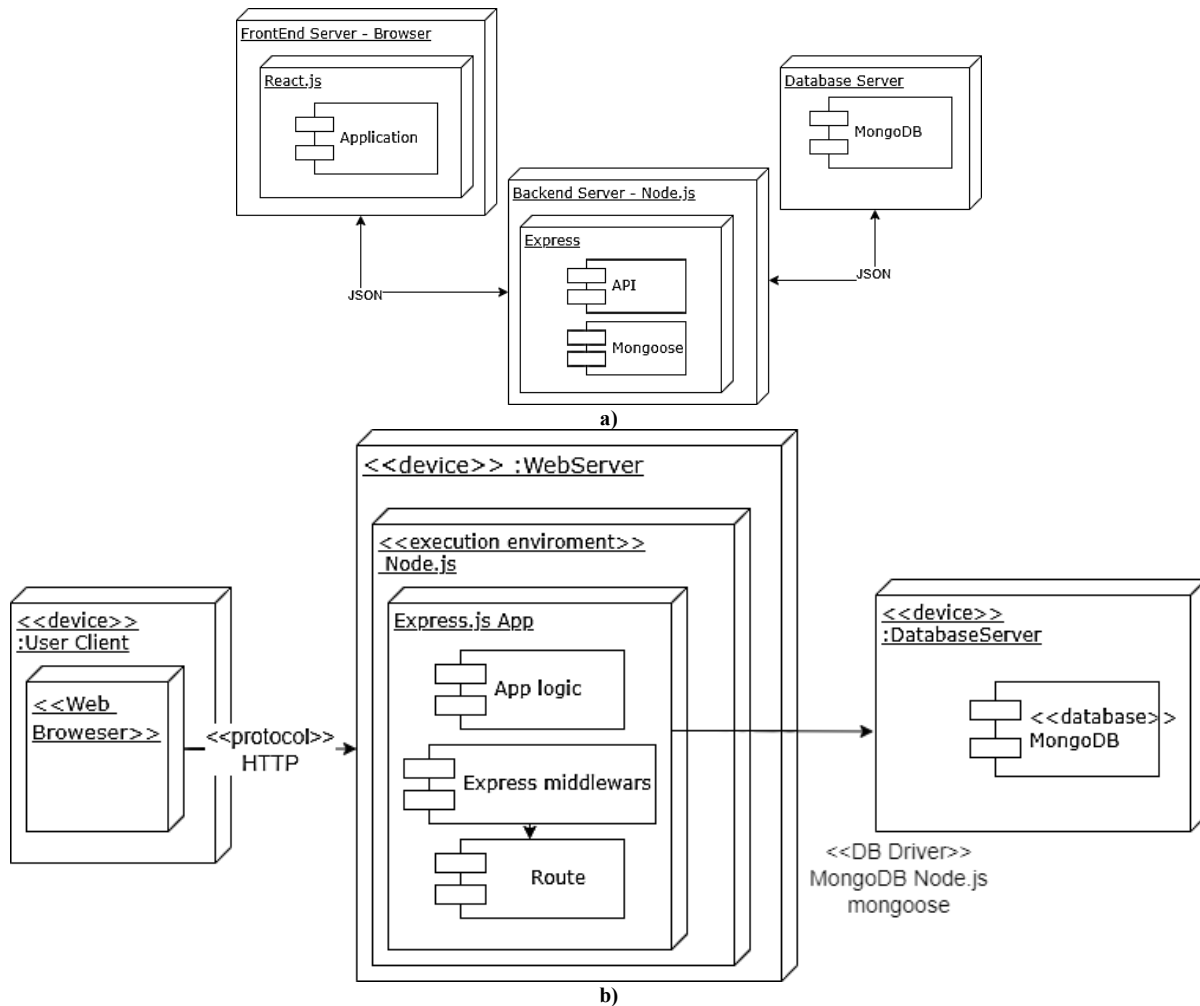


Fig.4. Visualization of the topology of the physical components of the system to model the physical aspects of the system: Component Diagram; b) Deployment Diagram

UML case diagrams, which model system functionality using actors and use cases, were defined for design choices and development priorities. Diagrams of precedents for this project with a list of all possible actions (Fig. 5).

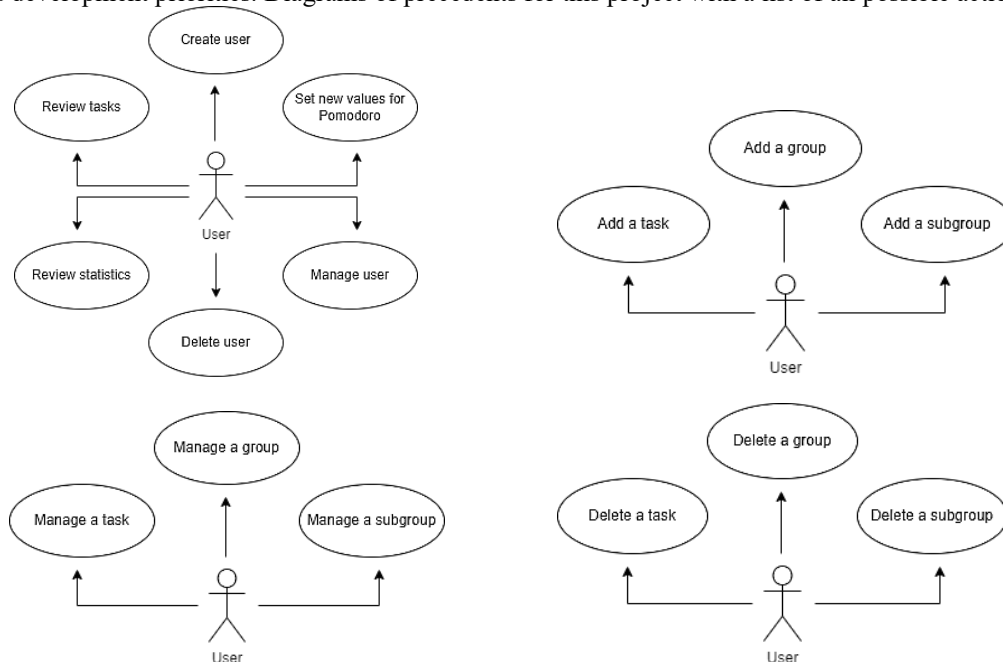


Fig.5. Precedents Diagram

The class diagram represents the static view of the application. It represents the types of objects in the system and the relationships between them. The class diagram of this project has a type of relationship with composition, that is, if a user is deleted from the database, then all groups and tasks created by him are deleted. Also, if a user is created, it can have many groups, or none, but if a subgroup of groups is created, or a task in a subgroup, then there can be from one to many in the parent class (Fig. 6).

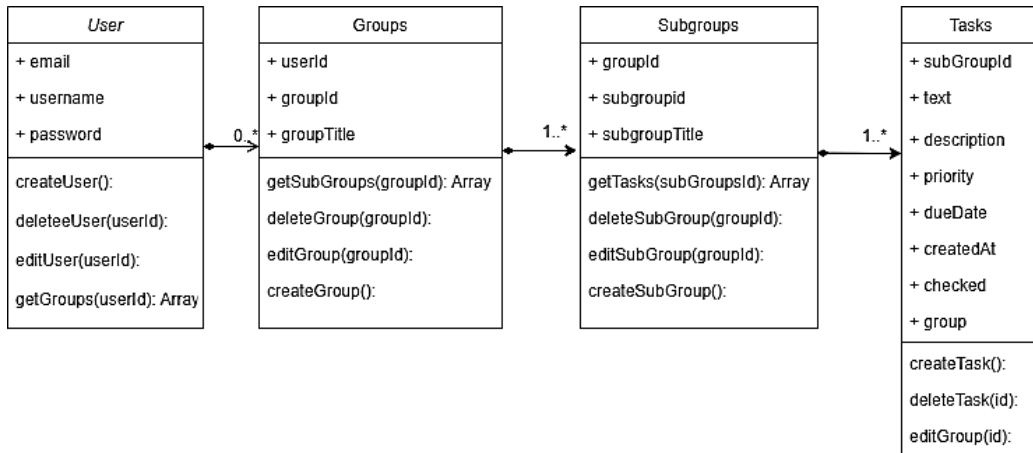


Fig.6. Class diagram

The object diagram reflects the specific (actual) behavior of the system (Fig. 7).

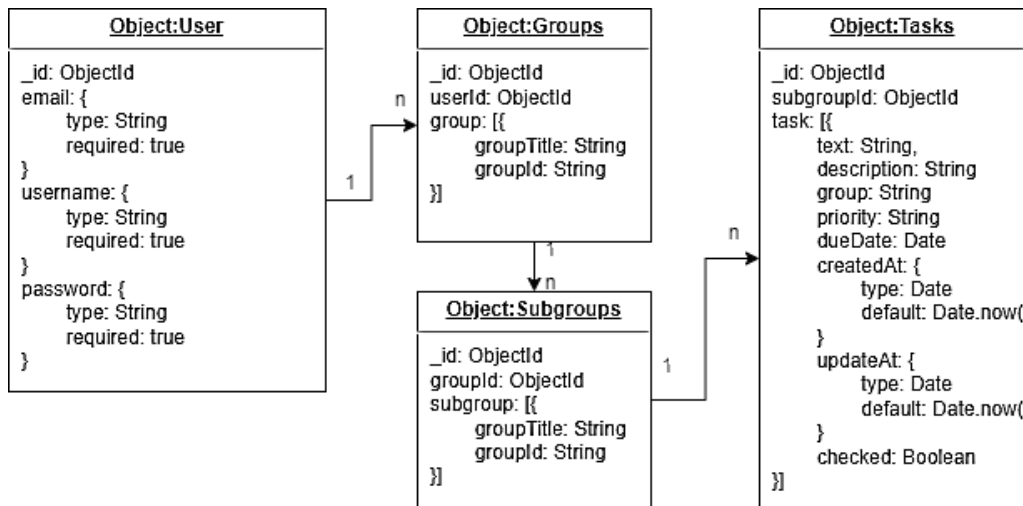


Fig.7. Object Diagram

The server part consists of the following modules (Fig. 8):

- config – file with services, project services;
- routes – is a file with all paths, "routes", with specified callback functions;
- models – designed database tables;
- controllers – file with appropriate callback functions for paths.

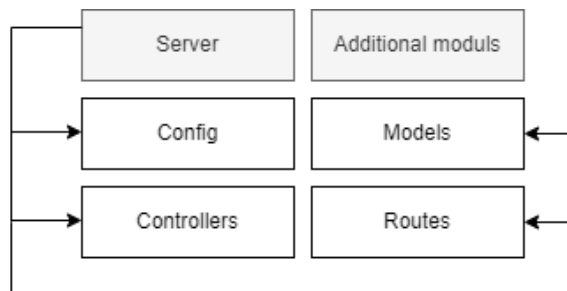


Fig.8. The structure of the server part

The following tools were used to develop the server:

- cors is an HTTP header-based mechanism that allows the server to specify any sources (domain, scheme, or port) other than its own from which the browser should allow resources to be downloaded;
- dotenv is a zero-dependency module that loads environment variables from an .env file into process.env;
- express is a Node.js framework designed to quickly create APIs and facilitate node js work;
- mongoose is a MongoDB object modeling tool designed to work in an asynchronous environment;
- nodemon is a tool that helps develop Node.js applications by automatically restarting the node application when directory file changes are detected;
- jsonwebtoken is an open standard that defines a compact and autonomous way to securely transfer information between parties as a JSON object;
- bcryptjs is a password hash function;
- body-parser – parses the body of incoming requests in the middleware before the handlers are available in the req.body property.

The client part has the following structure (Fig.9).

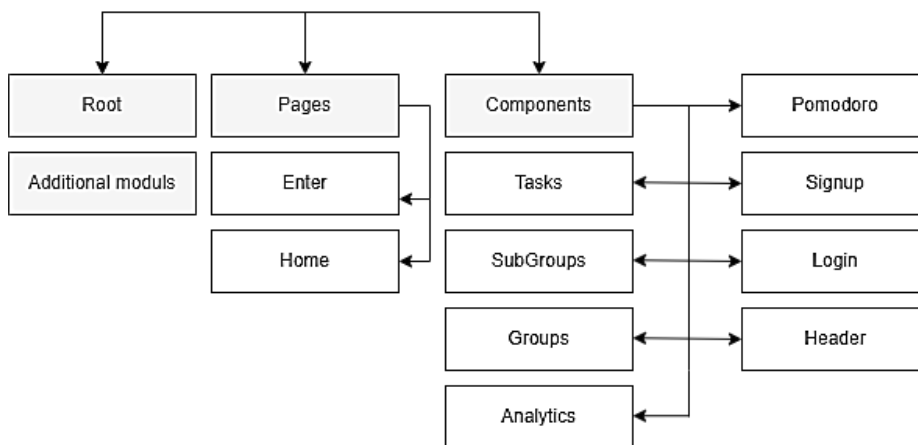


Fig.9. Structure of the client part

A batch diagram, which is a type of structure diagram, shows the location and organization of model elements in a project. This project has the following batch diagram shown on Figure 10.

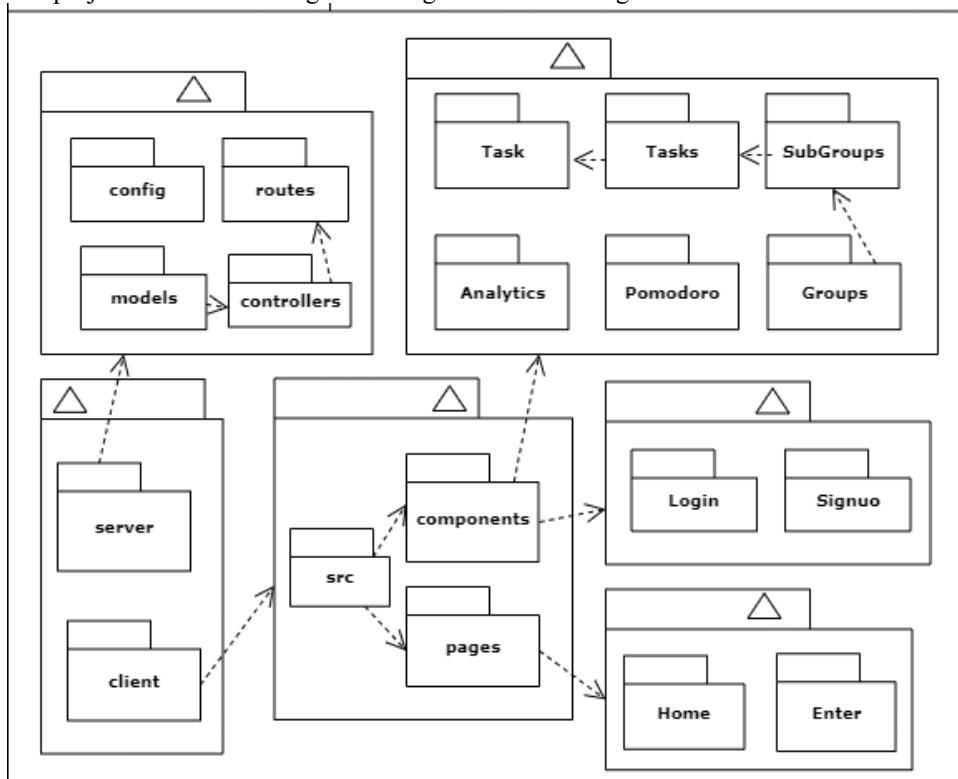


Fig.10. Batch diagram

With the help of the online vector service Figma, a prototype of the Web application was developed, which made it possible to test, simulate and virtually explore the usability of the product before its creation. The application has a minimalistic UI/UX design (Fig.11, 12), easy to use, and has a good emphasis on the components that the user interacts with. By using the React library and implementing a one-page creation method, the user does not waste time loading pages, thanks to the library's component approach. This increases the user experience with the site and its ease of use.

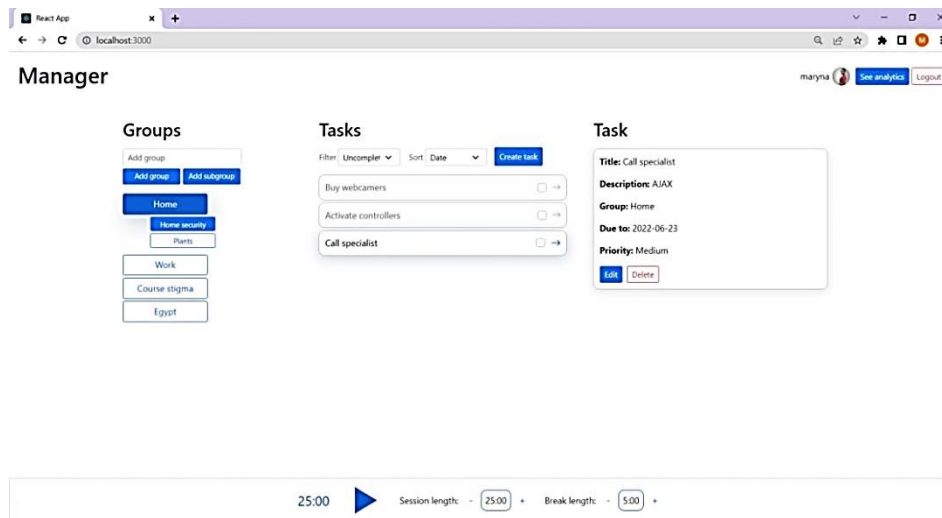


Fig.11. Screenshot of the main page

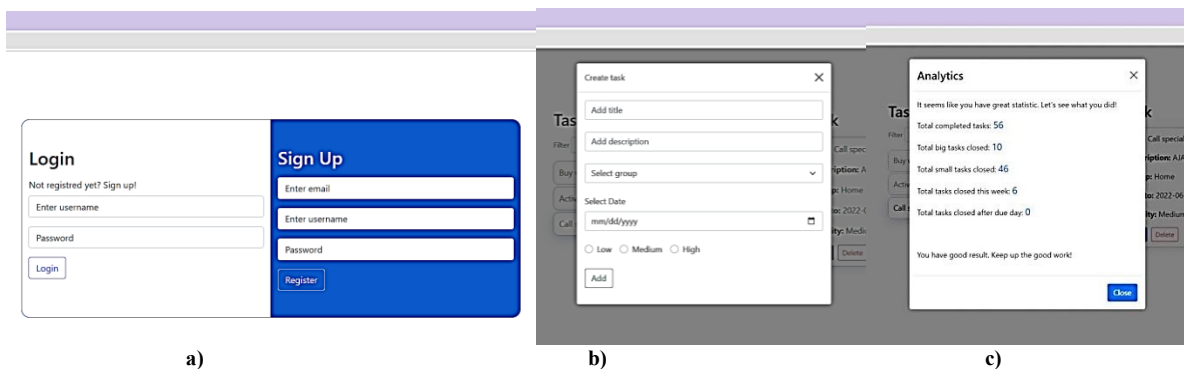


Fig.12. Screenshots: a) the Login screen; b) the task creation window; c) the analysis module window

Conclusions

The work developed a model that combines basic time management methods. Modeling of the information system based on a 3-level architecture based on the MERN technology stack was carried out using the unified modeling language UML and diagrams of precedents, deployment, classes, packages, components, which simplify the creation of the application logic and reflect the structure of the application. The design of the system was also carried out using the creation of a prototype in the online vector service Figma. A Web application with basic time management methods has been created.

As a result of the work, a user-friendly developed Web application was obtained with basic time management methods such as the Pomodoro timer, the ability to divide tasks into groups and subgroups and the priority of tasks and analyze the result with a minimalistic UI/UX design for convenient implementation of time management.

In the process of development, a system of rewards and incentives for completing tasks, which will be integrated into the system in order to motivate the user.

References

1. Thoughts on Moral Letters to Lucilius: Letter 1 - On Saving Time. URL: <https://0xedward.io/thoughts-on-moral-letters-to-lucilius-letter-1-on-saving-time/>
2. Іван Примаченко про онлайн-навчання на карантині. URL: <https://www.radiosvoboda.org/a/30582636.html>
3. Social eLearning: A Strategy for Increasing Online Course Completion Rates. URL: <https://www.novoed.com/resources/blog/elearning-social-completion-rates/#:~:text=Completion%20rates%20in%20online%20courses,low%2C%20averaging%20around%202013%25.>
4. Stella Cottrell. The Study Skills Handbook / Stella Cottrell. – Palgrave Macmillan, 2013. – 123p.
5. David Allen. Getting Things Done: The Art of Stress-Free Productivity, 2015. - 352p.
6. Time Management. URL: <https://corporatefinanceinstitute.com/resources/management/time-management-list-tips/>
7. Brian Tracy. Eat That Frog!: 21 Great Ways to Stop Procrastinating and Get More Done in Less Time, 2017. - 144p.
8. Pomodoro Technique Considered Harmful URL: <https://arialdomartini.wordpress.com/2014/05/19/pomodoro-technique-considered-harmful-dont-worry-you-are-not-using-it/>

9. Habitica URL: <https://habitica.com/>
10. Tweek URL: <https://tweek.so/>
11. MyLifeOrganized URL: <https://www.mylifeorganized.net/>
12. Clear URL: <https://apps.apple.com/us/app/clear-todos/id493136154>
13. Lothar Seiwert. Mehr Zeit für das Wesentliche. So bestimmen Sie Ihre Erfolge selbst durch konsequente Zeitplanung und effektive Arbeitsmethodik. mi (Moderne Industrie), Landsberg am Lech 1984 (Erstausgabe), ISBN 3-478-32770-9.
14. Н.С. Краснокутська, О.М. Нащекіна, О.В. Замула та ін. Менеджмент: навчальний посібник. Харків: «Друкарня Мадрид», 2019. – 231 с.
15. Richard Koch. The 80/20 Principle. Nicholas Brealey Publishing, 1997, Doubleday 1998. ISBN 0-385-49174-3
16. ABC Method Time Management: What It Is & How to Implement. [URL: <https://biz30.timedoctor.com/abc-method-time-management/#2-alpen-method>]
17. Francesco Cirillo. The Pomodoro Technique. URL: <https://francescocirillo.com/products/the-pomodoro-technique#>

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