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на тему «Програмний комплекс для збільшення словникового запасу малюків та вивчення іноземних мов. Частина 2. Розробка програмного комплексу для мобільних пристроїв»

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Thesis

to Master's qualificationwork
on the topic «Software for increasing the vocabulary of children and learning foreign languages. Part 2. Development of software for mobile devices»

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АНОТАЦІЯ

В даній магістерські кваліфікаційній роботі розглянута проблематика впровадження сучасних інформаційних технологій в навчальний процес, зокрема, для вивчення інозмених мов та поповнення словникового запасу малюків. Наведено сучасний стан застосування інформаційних технологій в навчанні, визначено переваги та недоліки впровадження інформаційних технологій в навчальний процес. Проаналізовано та порівняно сучасні методи поповнення словникового запасу малюків. Проаналізовано існуючі рішення для вивчення іноземних мов та поповнення словникового запасу малюків.

Розроблено та протестовано інформаційну систему, призначену для вивчення мовних конструкцій іноземних мов. Результати роботи додатку порівняні з існуючими аналогами. Наведено висновки про доцільність розробки і впровадження подібної інформаційної системи в навчальний процес.

ANNOTATION

The problems ofmodern information technologies introduction to the educational process, in particular, for the study of foreign languages and replenishment of the vocabulary of children are consideredin this master's qualification work. The current state ofinformation technologies application in training is presented, advantages and disadvantages ofinformation technologies in the educational process introduction are determined. Modern methods of replenishing the vocabulary of children are analyzed and compared.Existing solutions for learning foreign languages and replenishing the vocabulary of children have been analyzed.

The information system for studying language constructions in foreign languages has been developed and tested. The results of the application are compared with existing analogues. The conclusions about the feasibility of developing and implementing such an information system in the educational process are given.

CONTENT

INTRODUCTION

*Topicality.*Nowadays, the role of information technology in thelives of people has grown significantly. Modern society is undergoing a generally historical process called informatization.This process involves access of any citizen to information resources, the introduction of information technologies in scientific, industrial, public spheres and a high level of information services.The processes caused by the informatization of society influence the acceleration of scientific and technological progress, the intellectualization of various types of human activities, and the formation of a new information environment for the society.

One of the key directions of the process of informatization of society are the informatization of education. It is a system of methods, processes, and software that interact to collect, process, store and uses information.The purpose of informatization is to activate the intellectual activity of mankind through the introduction of new information technologies.

Information technology offer the following benefits:

- make learning more effective by attracting different types of sensory perception to the student and equipping teachers with new conceptual tools;
- enable more rational organization of students' cognitive activity during the educational process;
- adjust educational programs for children with different abilities and learning styles;
- use computer features, allowing to personalize the learning process and use brand new cognitive tools;
- intensify all levels of the educational process [1].

The benefits that information technology gives us make the learning process much easier. The main pedagogical goals of information technology are aimed at the development of the student's personality, which includes: development of communicative abilities, development of creative thinking, ability to make unusual

decisions in difficult situations; improving knowledge of experimental activities.

Information technologies enable the development of new interactive methods and the organization of learning as a collective activity of students. Information technology in education allows for a variety of forms and methods of learning to more effectively absorb information through the clarity of information that information technology can fully provide.

Thus, the informatization of education leads to the evolution of certain aspects of the educational process. The process of interaction between the student and the teacher changes. The student can use a large amount of various information, collect it, process it. The teacher is freed from routine work and has the opportunity to analyze the learning process in more detail, to track the student's success. However, at the moment, to a greater extent, teachers are not ready to move from the usual teaching methods to the use of information technologies in the educational process. In most cases, computers are used as a complementary learning tool.

The introduction of information technology makes it possible to improve learning activities, increase the efficiency of the educational process and increase the level of individual activity of students. In addition, the use of information technology in the educational process trains qualified specialists in the development and application of modern technologies [2].

The recent development of information technology has led to the emergence of many new devices and technologies such as tablets, smartphones, netbooks and more. The world has begun to move away from the concept of "computer" as an exclusively standard personal computer. Mobile devices are steadily entering our lives and becoming commonplace. The leading platform among such gadgets today is Android OS.

Android is used on a variety of devices. These are smartphones, tablets, TVs, smartwatches and a variety of other devices. According to various estimates for 2017, this operating system is used by about 85% of smartphone owners and the total number of smartphone users on Android OS is about 1.5 billion people

worldwide [3].

Nowadays, technologies have reached a level of development where much of the functionality of personal computers can be ported to mobile devices. The process of learning foreign languages is no exception. It is extremely important to gain access to knowledge anywhere and with the development of mobile technologies, it becomes possible.

The aim of the study is development of the new information system that uses new highly efficient learning tools received by analysis of the most effective learning methods and instruments.

To achieve this goal the*following tasks* should be resolved:

1. To analyze modern state of the implementation information systems into the learning process;

2. To analyze modern information systems of the foreign language learning and methods of the vocabulary of children replenishment, to make comparative analysis, find advantages and disadvantages;

3. To design universal information system designed for foreign language learning and vocabulary of children replenishment based on analyses.

4. To inquire modern approaches and technologies that can be used in development of information system;

5. To develop information system using inquired technologies and instruments;

6. To test developed information system and analyze it effectiveness and expediency of implementation.

Object of the study – the process of the foreign language learning and vocabulary replenishment of kids.

Subject of the study – foreign language learning and vocabulary replenishment of children methods and instruments.

Methods of the study that was used in the scientific work:

– comparison - to determine the advantages and disadvantages of existing methods and techniques that will be taken into account when developing an information system;

– generalization - to determine the general properties and characteristics of existing methods of learning foreign languages and replenish the vocabulary of children;

– modeling - to represent the logic of information system functioning in the form of diagrams and diagrams;

– formalization - for converting diagrams and diagrams into code of programming languages;

– analysis - to divide the object of study into components for the purpose of their independent study;

– experiment - to test and determine the effectiveness of the created software application, to analyze the feasibility of creating it.

The scientific novelty of the work is the design and development of a new information system for teaching children using new highly effective learning tools based on comparisons of the most modern methods.

The main scientific and technical result of the work - new information system was presented, which, unlike existing analogues, increases the efficiency of learning foreign languages and the vocabulary of children replenishment by using new highly effective means of learning, obtained by analyzing the most effective methods of language learning used nowadays.

Approbation. Master's qualification work and some aspects of it, the generalizations and conclusions were prepared for publication at the scientific conference "Youth in Science: Research, Problems, Prospects" (2020).

Publications. The results of the work were prepared for coverage in the scientific-technical conference "Youth in Science: Research, Problems, Prospects" (2020).

1 PROBLEM ANALYSIS AND LITERATURE REVIEW

1.1Application of information technology in education

Information technologies are used in all spheres of human activity, distributed through information flows in society, form the global information space. Today in the world they are becoming more widespread, because society needs informationupdating. Almost all spheres of society use information technology. A central part of this process is the computerization of education.

Computer technology has penetrated and continues to penetrate into all spheres of human activity. It is impossible to imagine a single industry in which electronic computers were not used. The education sector was no exception and was also computerized. Moreover, computers are not considered as an additional means of learning, but as an integral part of the holistic educational process, designed to significantly increase its effectiveness [4].

In modern education systems, the most common multifunctional office applications and IT tools are:

– spreadsheets;

– text editors;

– presentation preparation programs;

– organizers;

– database management systems;

– graphic packages.

Using IT in the learning process helpsto:

– improve the cognitive activity of students;

– consider modeling and visualization of complex processes and phenomena;

– show interest in the study of individual subjects;

– use the Internet when finding the information, you need.

Benefits of using IT:

– use of audio and video information during classes;

– mastering the subject using graphic information;

– the possibility of using a differentiated approach to students of different levels of readiness;

– the possibility of the most rapid contact between teachers and students [5].

One of the modern ways of improving the educational process at school is the informatization of education, and in particular, the use of information technology. Informatization of education includes not only the informatization of teaching. This is the informatization of educational activities, monitoring and measuring learning outcomes, educational processes, extracurricular, research and scientific and methodological activities, as well as organizational and managerial activities. Information technologies in the educational process help to absorb information more deeply while studying subjects and facilitate the work of teachers in the course of classes.

The definition of the main directions of innovative activity in the field of education should be based on the idea of the important functions that the educational system implements in society and a comprehensive analysis of the current problems in this area. Speaking about the functions of education, it should be noted that the education system is one of the main institutions of socialization of a person in society, the formation of a harmoniously developed, socially active, creative personality, as well as an important factor in the implementation of the tasks of socio-economic and cultural development of society. In this regard, the ability of the educational system to respond promptly and flexibly to the needs of society is of paramount importance, given the main trends in its development. The implementation of this task cannot be achieved only through the introduction of new technical means and technologies.

The need to introduce new training technologies that are adequate for today has thus become an objective necessity. It should be noted that the students

themselves are primarily interested in receiving such an education that will help them adapt in a rapidly changing world. The systematic use of multimedia has a significant impact on student development. Studying the features of attention in multimedia lessons revealed not only the student's external activity, but also internal, based on curiosity[6].

Based on the analysis of the work of domestic and foreign researchers, teachers, psychologists, it was shown that the use of multimedia can solve didactic issues with a great educational effect, can be a means of increasing the effectiveness of training, significantly reduces the time taken to study compulsory educational material, and makes it possible to deepen and expand the range of issues and issues [7].

In accordance with international standards, innovations are defined as relevant and systemically self-organizing neoplasms that arise on the basis of a variety of initiatives and innovations that become promising for the evolution of education and positively affect its development, as well as the development of a wide multicultural educational space. The concept of "innovative activity" in relation to the activities of educational institutions can be considered as a targeted transformation of the content of training and the organizational and technological foundations of the educational process, aimed at improving the quality of educational services, the competitiveness of educational institutions and their graduates, ensuring comprehensive personal and professional development of students [8]. Thus, innovative activity transforms the nature of learning in relation to its parameters such as target orientation, nature and content of the interaction of the main subjects of the pedagogical process. The following characteristics can serve as indicators of the new quality of the educational process: new knowledge, the formation of the basic competencies of students, increasing the level of their personal development; lack of negative effects and consequences (overload, fatigue, poor health, mental disorders, lack of educational motivation, etc.); increasing the professional competence of teachers and their attitude to work; the growth of the prestige of the educational institution in society, expressed in the

influx of students and teachers, etc.

Today, there is a very large gap between the ownership of technology that traditional education graduates have given and the technologies that are used in everyday life. This is a culture of presentations, and a system of persuading customers. Very often, today's graduates of many universities have very poor knowledge of these skills, which is largely due to the insufficient use of modern audiovisual technologies in education. One of the problems of the modern information society is that knowledge becomes obsolete from the moment it is transferred to the audience, and the use of distance technologies allows you to convey relevant knowledge directly at the moment when ideas born in a university can be implemented in a specific field of activity. This is the meaning of open education with the help of distance technologies and the use of electronic teaching aids.

In the educational process, there is an intensification of information flows for educational purposes (Internet and network resources, electronic libraries and databases, forums, newsgroups, computer models, simulators and simulators, network tools for organizing “virtual” teamwork, etc.).

The main educational value of information technologies is that they allow to create an immeasurably brighter multi-sensory interactive learning environment with almost unlimited potential opportunities that are available to both the teacher and the student. Unlike conventional technical teaching aids, information technologies allow not only saturating a student with a large amount of knowledge, but also developing students' intellectual, creative abilities, their ability to independently acquire new knowledge, and work with various sources of information.

The functions of a computer as a tool for a student’s activities are based on its ability to accurately record facts, store and transmit a large amount of information, grouping and statistical data processing. This allows to use it to optimize learning management, increase the effectiveness and objectivity of the educational process with significant savings, the teacher’s time in the following

areas:

- obtaining information support;
- diagnostics, registration and systematization of training parameters;
- work with training materials (search, analysis, selection, design, creation);
- organization of teamwork; implementation of distance learning.

While working with educational materials, the PC provides the teacher with various types of assistance, which consists not only in simplifying the search for the necessary information when creating new educational materials through the use of reference and information support systems, but also in the design of teaching materials (texts, figures, graphs), as well as in the analysis of existing developments. Automatic analysis, selection and prediction of the effectiveness of educational materials are important areas of using a computer as a tool for information support of the learning activity. The teacher can not only conduct the selection of materials for training (make lexical and grammatical minimums, select texts and exercises), but also analyze texts and entire textbooks [9].

Due to the possibilities of implementing the functions of a teacher, a computer is often used in the process of students' independent and homework, in the course of autonomous language learning, in order to fill the knowledge gaps with lagging students. In this situation, training and educational computer programs specially created for educational purposes are used.

We can say that the computer from the "teacher" is turning into an active assistant to the teacher. Along with informative content, an interactive lecture has an emotional connotation due to the use of computer slides in the process of its presentation. In advance, preparing for the lecture, the teacher develops the necessary number of slides on the computer in the Power Point application of the Office program, supplementing the video information on them with sound and animation elements. Naturally, this significantly increases the requirements for teacher qualifications. He must possess the necessary level of knowledge of computer technology and have the skills to work with software. An important condition for conducting an interactive lecture is also the presence of a specialized

audience equipped with computer equipment and modern means of public demonstration of visual and sound educational material. In the process of presenting the lecture, the teacher occasionally presents information on the slide as an illustration.

Thus, the participation of both the teacher and the computer in the learning process significantly improves the quality of education. Using the proposed methodology activates the teaching process, increases students' interest in the discipline under study and the effectiveness of the educational process, allows to achieve a greater depth of understanding of the educational material. On the one hand, the cooperation of the teacher and the computer makes the discipline more accessible for understanding by various categories of students, improves the quality of its mastery. On the other hand, it imposes higher requirements on the level of teacher training and his qualifications, which should not only own traditional teaching methods, but also be able to modernize them in accordance with the specifics of the students, using modern achievements of science and technology.

1.2 Application of information technology for learning foreign languages

Over the past years, many foreign language teachers have been worried about the search for new teaching methods. Methodists in many countries are engaged in the analysis of existing methods and technologies and their adaptation to modern realities and requirements and at the same time are looking for radically new approaches. There is debate about how the process of teaching a foreign language in a modern school should look like. Some teachers advocate the preservation of traditional methods, while others want to completely change the whole system. There is a third category of teachers, offering to combine new and old forms. But no one doubts that change is inevitable. This is due to a number of

factors: requirements for the ultimate goals of language learning, the psychology of a modern student, and, of course, technological changes in the world around us.

The current time is a period of intensive development of technologies, primarily computer ones. This leads to the fact that modern students better perceive and assimilate new information through contact with computer information sources. The use of computer technology in the process of learning a foreign language makes it possible to make this process easier for students and create an environment familiar to them. It also allows you to diversify the work and make it more interesting for students. Thanks to multimedia resources, the process of learning a foreign language can be moved beyond the classroom and made continuous. In some cases, the desire and need to learn a language comes as a result of using these resources (communicating online with native speakers, watching programs and films in a foreign language, using various sites that require knowledge of a foreign language).

Teaching a foreign language using computer technology includes:

– authentic language material, such as video clips, flash animations, webquests, podcasts, news, etc.

– an online environment in which students can communicate with native speakers of a foreign language via e-mail, text computer editors, social networks, voice or video conferences;

– language learning tools (online applications and programs) aimed at studying phonetics, pronunciation, vocabulary, grammar and sentence analysis. Tools include text-to-speech exercises, speech recognition, interactive and controlled tasks;

– an online environment that enables communication between the teacher and students, students with each other;

– game forms of training.

Despite the insufficient study of the impact of the use of computer technology in the study of foreign languages, we can certainly speak about its positive effects. By reviewing all existing data, we can conclude that with the help

of computer training systems students demonstrate achievements in speaking, reading, understanding, and vocabulary stock, grammar and fluency. In addition, it can be argued that computer-based training programs provide better monitoring and evaluation of student work. Computer-based training programs serve as a teacher, giving direct, clear instructions and evaluating student work. Such a system usually consists of four components: an interface (platform), a model model (the topic and knowledge that the student must master), a student model (the current level of student knowledge), and a teaching model (which provides control and instructions based on the difference between the student model and sample).

A large number of studies and practice show that students get more pleasure from using technologies in studying a foreign language and prefer them to more traditional methods and materials. Thanks to technology, students are more involved in the learning process and are more positive about it. Students perceive the use of a computer as an innovative and attractive method, and their adaptation often proceeds faster than the adaptation of a teacher. The use of computer technology can reduce student anxiety by providing an independent, non-grading learning environment in which students feel more relaxed and enjoy the process of learning a language more. Online audio and video resources increase interest in learning a foreign language and allow you to use a fascinating and spontaneous approach that stimulates the emotional response of students to language material.

Computer technologies develop students' independent work, allowing them to independently choose the pace of studying the material, tasks necessary to achieve the set educational tasks, place and time of work. Emails and other types of computer-based writing work encourage self-control, as they require verification of what is written before the final version is printed. Students can feel more confident and calmer when they write, rather than speak, a foreign language.

It can be concluded that computer technology can be of great benefit in the development of language competencies, provided that they are competently and intelligently used. Their importance for independent work of students is becoming increasingly important. They help to overcome the language barrier and

psychological complexes of students. Computer technology develops students' interest and motivation in learning a foreign language. Internet resources form the skills of intercultural communication and knowledge of another culture. All these advantages prove the need to integrate computer technology into the modern educational environment [20].

1.3 Application of information technology inchildren's education

Today, information technology significantly expands the capabilities of parents, teachers and specialists in the field of early learning. The possibilities of using a modern computer allow to most fully and successfully implement the development of the child's abilities.

Unlike conventional technical teaching aids, information and communication technologies allow not only saturating a child with a large number of ready-made, strictly selected, appropriately organized knowledge, but also develop intellectual, creative abilities, and what is very important in early childhood is the ability to independently acquire new knowledge. The computer is actively entering our lives, becoming a necessary and important attribute not only of adult life, but also a means of teaching children. The use of modern computers in work with preschool children is just beginning. Currently, this is due to the need for significant changes in the system of preschool education. The success of these changes is associated with updating the scientific, methodological and material base of the preschool institution. One of the important conditions for updating is the use of new information technologies.

The computer’s ability to reproduce information simultaneously in the form of text, graphics, sound, speech, video, memorize and process data at a tremendous speed allows specialists to create new means of activity for children that are fundamentally different from all existing games and toys. All this makes qualitatively new demands on preschool education, the first link in lifelong education, one of the main tasks of which is to lay the potential for enriched development of the child’s personality. Therefore, in the system of preschool

education and training, it is necessary to introduce information technology. Practice shows that at the same time, children's interest in classes increases significantly, and the level of cognitive opportunities increases. The use of new unusual methods of explanation and reinforcement, especially in a playful way, increases the involuntary attention of children, helps to develop voluntary attention. Information technology provides a personality-oriented approach. Computer capabilities allow to increase the volume of material offered for review. In addition, among preschoolers, the same program material should be repeated many times, and the variety of presentation forms is of great importance.

Computer programs accustom themselves to independence, develop the skill of self-control. Young children require more help in completing assignments and step-by-step confirmation of their actions, and automated correctness control frees up the teacher’s time for parallel work with other children. The use of computer-aided learning tools also helps to develop composure, concentration, perseverance in preschoolers, and empathy. Computer capabilities allow to increase the volume of material offered for review. The bright luminous screen attracts attention, makes it possible to switch the children's perception of audio to visual, animated characters are of interest, as a result, tension is relieved. But today, unfortunately, there is an insufficient number of good computer programs that are designed for children of this age. Specialists identify a number of requirements that educational programs for children must satisfy:

- research character;
- ease for independent occupations of the child;
- development of a wide range of skills and ideas;
- high technical level;
- age compliance;
- entertaining.

The use of multimedia presentations makes it possible to present educational and developing material as a system of bright reference images filled with exhaustive structured information in an algorithmic order. In this case, various

channels of perception are involved, which allows you to put information not only in factual, but also in associative form into the memory of children. The presentation of material in the form of a multimedia presentation reduces learning time, frees up children's health resources. The use of multimedia presentations in the classroom allows you to build the educational process on the basis of psychologically correct modes of functioning of attention, memory, mental activity, humanization of the learning content and pedagogical interactions, reconstruction of the learning process and development from the perspective of integrity.

Thus, the use of computer technology allows to optimize the correctional and pedagogical process, individualize the education of children with developmental disabilities and significantly increase the effectiveness of any activity. In addition, in the process of designing, creating new tasks for correctional and developing classes using a computer and a multimedia projector, the teacher’s creative qualities are developed and improved, and his professional competence is growing. The desire of an adult to diversify the activities of children, to make classes even more interesting and informative, takes them to a new round of communication, mutual understanding, develops the personal qualities of children, and contributes to the excellent automation of skills acquired in the classroom at the new communicative stage of pedagogical and correctional impact. Thus, the informatization of education opens up new ways and means of pedagogical work for educators and teachers [27].

1.4Analog products analysis

There are a lot of information systems for learning foreign languages.

Incredibly well-designed and user-friendly, Duolingo is a free site that teaches users languages through drills, requiring a mix of reading, writing, listening, and speaking. An “immersion” section allows to read real-world articles

while helping to translate them. Beyond that, Duolingo makes studying by awarding points for lessons completed and bonuses if everything does well; a social aspect allows your friends to see your progress and vice versa. If you wish, Duolingo will send you daily reminders to study, which is easy to do, even while you're on the go, if you download their free app. Currently, the site offers instruction in Spanish, French, German, Italian, Portuguese (Brazilian), Dutch, Irish, Danish, and Swedish. This information system is available for PC, Android OS, iOS and for Windows Phones [31]. Duolingo Information System is shown on the figure 1.2.

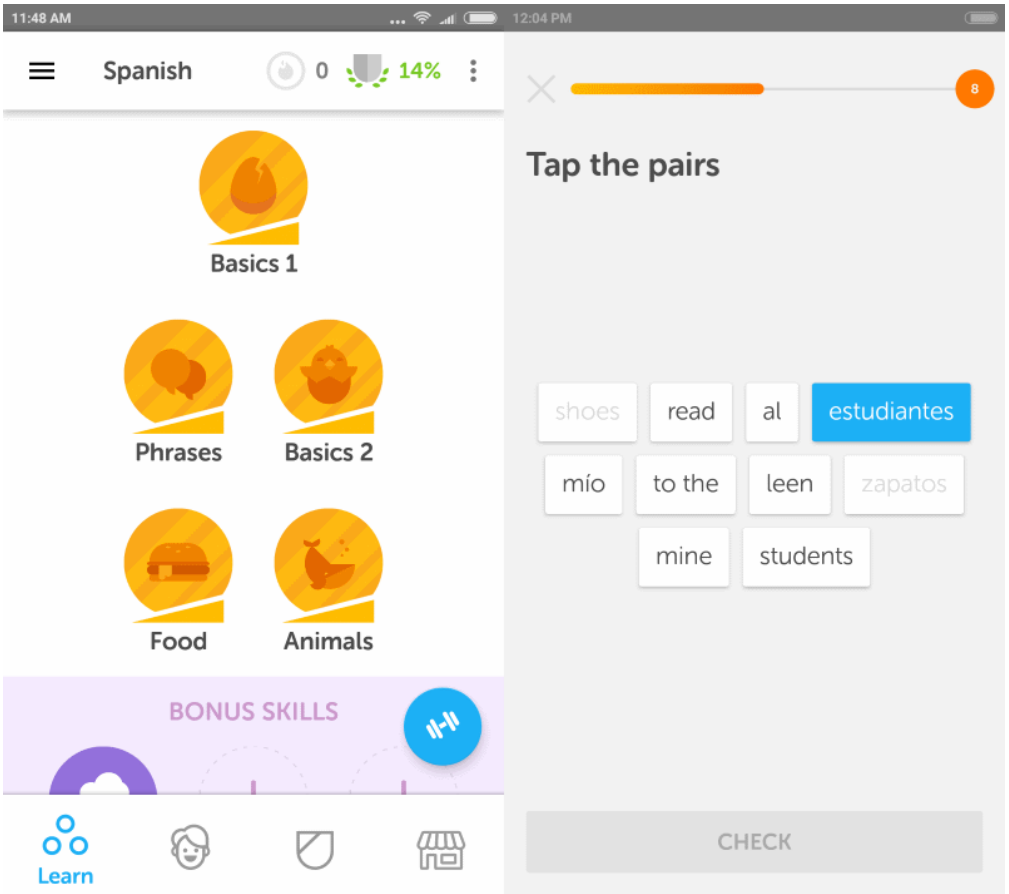


Figure 1.2 – Duolingo Information System

Livemocha, which provides lessons with native speakers in more than 35 languages. Reading, writing, speaking, and listening are studied separately on its platform, with structured lessons that first present new material before asking users to apply what they've learned. Premium membership isn't free, but you can earn

lesson credits by tutoring other clients (e.g., editing something that they've written in users' native language, or giving feedback on their pronunciation via audio recordings). Livemocha also allows its users to access virtual classes or book private tutors for online sessions [32].Livemocha Information System is shown on the figure 1.3.

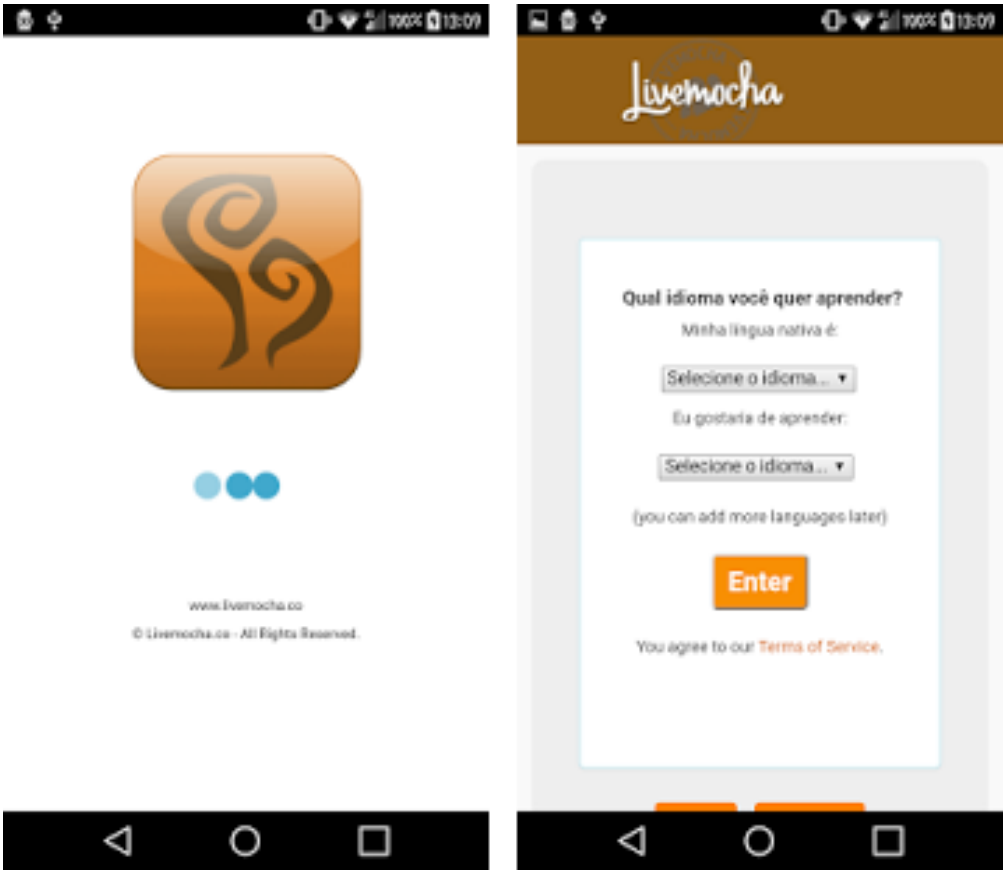


Figure 1.3 – Livemocha Information System

BBC Languages is very aesthetically pleasing, even though the organization is a bit confusing. The site is aimed at travelers, who only need to have a basic knowledge of a few key phrases in order to stay in a foreign country. Thus, BBC Languages offers "Quick Fix Phrases" in 36 languages to aid the weekend traveler in surviving abroad.

In its "Quick Fix" section, BBC Languages showcases useful phrases in 40 languages, but the site's strong suit is the comprehensive lessons it offers in seven languages: French, German, Spanish, Italian, Greek, Portuguese, and Chinese. For

these foreign tongues, the site conducts assessment tests to identify your level as beginner, intermediate, or advanced, and accordingly provides resources like PDF vocabulary lists and crossword puzzles. Video lessons are the most valuable component on the site, as it’s difficult to find similar offerings for free elsewhere.

BBC Languages available through its website. [33]. BBC Language Information System is shown on the figure 1.4.

Figure 1.4 – BBC Language Information System

With an international community of more than 40 million registered native speakers, Busuu relies heavily on its customers' efforts to help teach each other. Beginners lessons use flash cards for learning new words and phrases, but advanced lessons involve writing and answering questions that will be reviewed by native speakers on the site. Dialogues, writing exercises, and audio recordings are also part of the mix, but grammar-focused lessons, video units, and printable PDF files are only available via paid memberships. However, the free lessons are available on-the-go via Busuu’s apps. Bussu’s app also available in AppStrore an Google play for Android smatrphones and Apple smartphones the site offers

instruction in Spanish, German, French, Italian, Portuguese (Brazilian), Russian, Polish, Turkish, Arabic, Japanese, and Chinese [34].The Busuu Language Information System is shown on the figure 1.5.

Figure 1.5 – Busuu Language Information System

1.5Application fields analysis

Information systems for learning languages can easily implemented in schools learning program for beginners and for schoolchildren which have intermediate level of knowledge. Because foreign language education, which is a very important requirement in career planning, also benefits both educators and students from traditional courses with the advantages provided by distance education technologies. Also, these information systems can be implemented in companies for employees to increase their level of knowledge of foreign

languages. For example, CNN, TechCrunch, NASA, TripAdvisor, Clavin Klein (American fashion house) are using these information systems [36].

These systems provide access to their information 24 hours a day.In addition, their applications for smartphones are very convenient for travel.

More than 16,000 people from over 150 different countries took part in the survey. Merely 2% of people consider books as an efficient tool to learn languages and only 3% believe it is CD-ROMs. Only 4% of people think a traditional classroom is the right place to learn a language.

The most efficient method to learn a language is online language learning using information systems [36].

37% of people believe that one of the best ways to learn a language is online. 24% specifically identify Web 2.0 platforms like busuu.com as the most efficient way to learn a language and 13% prefer individual online language learning. 32% of people believe that language courses abroad are most efficient.The diagram is shown on the figure 1.6 [35].

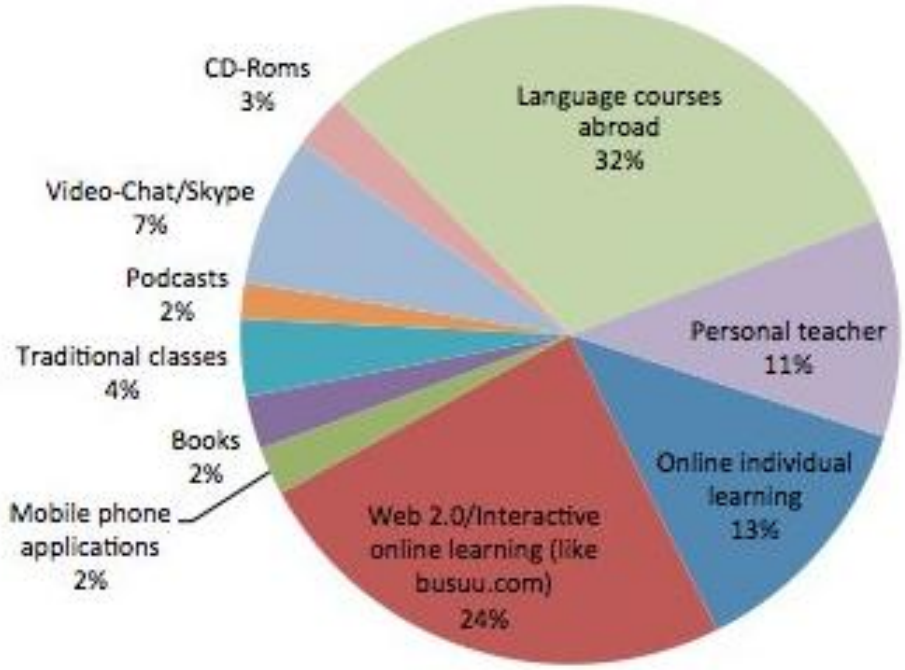


Figure 1.6 – Diagram of votes

1.6Choice of direction and tasks of research

On the basis of determining the status of the problem, it was found that the problem of developing an information system for learning foreign languages is quite relevant, especially in the context of the application of such functionality in the field of mobile technologies.

Thus, we formulate the objectives of the study:

– justify the choice of language and environment of software development;

– consider the tools of the chosen programming language that allow to handle HTTP requests;

– review and analyze software design templates that can be applied in the application;

– review and analyze approaches to designing the mobile application interface on the Android platform;

– based on the information obtained, develop a mobile application for the Android platform that allows to expand children's vocabulary and learn foreign languages.

2 RESEARCH OF TECHNICAL TOOLS FOR SOLVING THE TASK

2.1HTTP protocol for organizing data exchange on computer networks

HTTP (HypertextTransferProtocol) – a widespread data transfer protocol, originally designed to transmit hypertext documents (that is, documents that may contain links that allow the transition to other documents).

The abbreviation HTTP stands for "Hypertext Transfer Protocol". According to the OSI specification, HTTP is an application layer protocol.

HTTP protocol involves the use of a client-server data transmission structure. The client application forms the request and sends it to the server, after which the server software processes the request, generates a response and sends it back to the client. The client application can then continue to send other requests, which will be handled similarly.

A problem traditionally solved using HTTP is the exchange of data between a user application that accesses web resources and a web server. At the moment, it is through HTTP that the Internet is being secured.

HTTP is also often used as a communication protocol for other application layer protocols such as SOAP, XML-RPC and WebDAV. In this case, it is said that HTTP is used as "transport".

Many software APIs also involve using HTTP to transmit data - the data itself can be of any format, such as XML or JSON.

Typically, HTTP data is transmitted over a TCP / IP connection. The server software usually uses a TCP port 80 (and, unless the port is explicitly specified, then the client client software uses the 80th port by default for open HTTP connections, though it can use any what another.

By itself, HTTP does not involve the use of encryption to transmit information. However, HTTP is a widespread extension that implements the packing of data transmitted in SSL or TLS cryptographic protocol. The name of this extension is HTTPS (Hypertext Transfer Protocol Secure). For HTTPS

connections, TCP port 443 is commonly used. HTTPS is widely used to protect against hijacking information, and usually provides protection against man-in-the-middle attacks - if the certificate is verified by a client and the private key of the certificate was not compromised, the user did not confirm the use of the unsigned certificate and the certificates of the malicious certification center were not implemented on the user's computer [37].

2.2Architectural style for distributed hypertext systemsREST

REST (RepresentationalStateTransfer) – approach to the architecture of network protocols that provide access to information resources. It was described and publicized in 2000 by Roy Fielding, one of the creators of HTTP. REST is based on the principles of the Internet and, in particular, HTTP capabilities. Fielding developed REST in parallel with HTTP 1.1 based on the previous HTTP 1.0 protocol.

Data must be transmitted in a small number of standard formats (eg HTML, XML, JSON). Any REST protocol (including HTTP) should support caching, should not depend on the network layer of the OSI model, should not store status information between request-response pairs. It is believed that this approach provides scalability of the system and allows it to evolve with new requirements.

The REST antipode is a Remote Procedure Call (RPC) approach. The RPC approach allows the use of a small number of network resources with many methods and complex protocol. In the REST approach, the number of methods and the complexity of the protocol are strictly limited, which leads to the fact that the number of individual resources must be large [38, 76].

2.2.1 Architectural restrictions on the use of REST

REST, like any architectural style, meets a number of architectural constraints. This is a hybrid style that inherits limitations from other architectural styles.

The first architecture from which it inherits the constraints is the client-server architecture. Its limitation requires the separation of responsibilities between the components that deal with storage and updating of data (server) and those components that deal with displaying data on the user interface and responding to actions with that interface (client). This separation allows the components to evolve independently.

Another limitation is that the interaction between the server and the client has no status, that is, each request contains all the necessary information to process it, and does not rely on the server knowing something from the previous request. A lack of status does not mean that there is no status. This means that the server is unaware of the client's status. For example, when a client requests a homepage of a site, the server responds and forgets about the client. The client may leave the page open for several years before clicking the link, and then the server will respond to another request. In the meantime, the server may respond to other clients' requests or do nothing - it doesn't matter to the client.

Thus, for example, session state information (the authorizing user) is stored on the client and transmitted with each request. This improves scalability, since the server can release all resources involved in this operation after the query has been completed, without any risk of losing valuable information. It also simplifies monitoring and debugging because it is only necessary to look at one request to understand what is happening in a particular request. Reliability is increased because an error in one query does not affect the others [38, 78].

The downside of this limitation is that performance is decreasing as each request now has to add session data from the client. Also, maintaining the status of different clients is more difficult to maintain because client implementations may

differ, while the server environment is completely under the control of the developer [38, 79].

An additional limitation of the REST style is that systems written in this style should support caching, that is, data transmitted between the server should contain information about whether they can be cached and, if possible, for how long. This increases productivity by avoiding unnecessary queries, but also reduces system reliability because the cache data may be out of date.

The early Web architecture created by Tim Berners-Lee met these three constraints - a client server without a cached state [38, 80]. However, the REST style adds further limitations.

All components in the REST architecture support a homogeneous interface. This reduces the connectivity between the components and the services they provide and makes it easy to change components as needed [38, 81]. This is achieved by a few more specific limitations:

- identification of resources;
- manipulation of resources through representation;
- self-describing messages;
- hypermedia as an engine of the application state.

Another limitation for REST is the separation at the abstraction level. Each component gets to a certain level and communicates only with the components to the level below or to the level above. Limiting the knowledge of the system to one level reduces the complexity of the components [38, 82].

A recent architectural limitation in REST is that clients should be allowed to extend their functionality by downloading additional code in the form of applets or scripts. This simplifies the clients, not allowing them to implement all the necessary functions beforehand. However, this is not a mandatory restriction, and if it does not provide benefits for a particular application, then its implementation is not mandatory. For example, permission to download third-party code may be undesirable from a security perspective [38, 84].

2.2.2 REST architectural elements

The REST system components communicate by transmitting to each other a resource representation in a format selected from an updated set of standard data formats. The format is selected dynamically according to the wishes of the client component and the capabilities of the server. Whether the representation has the same format as the resource itself, or is the result of some kind of transformation is an implementation detail that is hidden behind the interface [38, 85].

A resource is a key piece of data in REST. A resource can be anything you can call it: a document (such as an image), a dynamic value (such as weather in a city), something from the real world (such as a company employee). But, to be more precise, the resource R is a function of the membership of MR (t), which reflects the moments in time by a set of identical entities or values. The set may be empty, ie REST allows reference to an object that does not yet exist [38, 88].

A resource can be dynamic (for example, a certain article may update its content from time to time), or it may be static and never change its value after it appears. In REST, these two resources are considered different, although at some point in time they may indicate the same entity. The only thing that matters is the semantics of mapping the resource name to its contents [38, 89].

Resource IDs are used to refer to resources. The component that provided the resource with the identifier and allows it to access the identifier is responsible for ensuring that the membership function remains unchanged. The quality of the identifier depends on the quality of the component that the identifier provides, so some identifiers become "dead links" when information is moved or deleted [38, 90].

Examples of resource IDs are:

– Uniform Resource Locator - URL;

– Uniform Resource Name - URN.

Views are a sequence of bytes and view metadata to describe those bytes. Often, views are called a document, file, HTTP message, and more.

Examples of presentation: JPEG photo, HTML document. An example of view metadata is media type, last modified time.

The view data in the view describes the purpose of the message between components, such as requesting an action (create, modify, delete a resource), or a response value (such as the current state of a resource, or the value of some other resource).

Also, the control data included in the queries or answers can control the behavior of the cache [38, 90].

The presentation data format is called media type. Some types of media are better suited for automatic processing, while others are better suited for displaying to the user. Composite media types can be used to combine or combine multiple views into one.

The latency of the user-friendly application depends on the data format. For example, the browser may begin to display the page before all HTML is loaded, which increases the apparent speed of operation [39, 70].

The connectors provide an interface for component communication, hiding resource implementations and communication mechanism.

The connectors are similar to a remote procedure call, but with some nuances in passing parameters and result. The parameters consist of a resource ID, control data, and optionally a view. The result is from the response and presentation control data. It is possible to abstract and consider such a call to be synchronous, but in fact data transmission is streamed, so data processing can be started before all the data is received, thus reducing latency.

The two most important types of connectors are client and server. The difference between them is that the client initiates the request while the server is waiting for requests and responding to them by giving access to their services. The component can contain both server and client connectors [38, 94].

An additional type of connector is the cache. The cache can be both client-side, to avoid unnecessary queries, and server-side, to avoid unnecessarily calculating the response to a query. Because the interface is homogeneous, the

cache can easily tell if the request can be cached. By default, a response to a resource request can be cached, and a resource change request is not. However, these silences can be overloaded with control data [38, 95].

Resolver is another type of connector that converts resource IDs into the network address information required by components to obtain this resource. For example, a URI contains a domain name, and to access that domain, you need to know the address from the DNS server. In this case, the DNS system plays the role of a resolver [38, 95]. Using one or more resolvers can increase the viability of the resource identifier because it does not point directly to the physical location of the resource, which may change.

The last form of connector is a tunnel that simply queries across the system, such as through a firewall. The reason why tunnels are included in the REST architecture rather than closed by network abstraction is that certain components can be transformed into tunnels upon request.

2.2.3 The semantics of HTTP

Although the resource can be anything, actions that can be performed on the resource are determined by messages that are described by the standard protocol. In WWW, this protocol is HTTP, but there are REST architectures based on other protocols.

The HTTP standard defines 8 types of messages, but the most commonly used are 4 of them:

– GET – get a view of the resource;

– DELETE – destroy the resource;

– POST – create a new resource on the site using the submitted view;

– PUT – change the status of the current resource to the state described by the submitted view.

The following types are used for API research:

– HEAD – get headers that would be sent along with a view of this resource, but not the view itself;

– OPTIONS – determine the list of methods that this resource responds to.

The other two CONNECT and TRACE methods are used only for HTTP proxies [8, 33].

There is also a ninth method, which is described not in HTTP but in RFC 5789:

– PATCH – change only part of the resource based on this view. If some part of the resource is not mentioned in the submitted view - do not touch it. This reduces the amount of information to be transmitted.

Two more methods are described in the Internet-Draft “snell-link-method” proposal:

– LINK – bind a particular resource to that;

– UNLINK – disconnect the resource from this.

The GET, PUT and DELETE methods are idempotent, which means that no matter how many times the operation they request is performed, the same result is obtained. Of course, DELETE will first return 204 No Content and then 404 Not Found, but there will be no resource after one delete, after ten. Idempotency is very important on a network where you do not know if the request has succeeded and, after receiving the answer, you send it again. POST is not idempotent, that is, by sending POST to create a message several times, you will receive several messages [40, 36].

URI templates for REST are described in RFC 6570 [41].

2.3Choosing a programming language and software development environment to solve the problem

The Android mobile platform allows a fairly wide range of programming languages to build applications on. Including:

– Java – the official development language for Android. Supported by Android Studio development environment;

– Kotlin – this language was recently introduced as the second officially supported language. It has many features in common as well as full Java compatibility;

– C/C++ –languages used mainly for writing mobile gaming applications;

– C# –a programming language implemented by Microsoft. Supported by Unity and Xamarin development environments;

– BASIC – a programming language supported by the B4A IDE development environment. It is a simple but powerful tool;

– Corona/LUA – LUA provides tools for cross-platform product development. It greatly simplifies application creation and provides access to native libraries;

– PhoneGap (HTML, CSS, JavaScript) – an option for those who have experience with interactive web pages. Allows similarly to create cross-platform applications [43].

The application developed in this master's thesis is intended to demonstrate the principles of storing, transmitting and processing information within the Android operating system, so the most widely used official programming language for Android is Kotlin. This language provides the most user-friendly and extensive development capabilities without requiring additional tools or layers to interact with an Android virtual machine.

Android Studio development environment was chosen as the programming environment. This is the official Android application development environment based on JetBrains IntelliJ IDEA. In addition to the powerful editor and tools for IntelliJ developers, Android Studio offers more productivity-enhancing capabilities for Android applications. These include:

– flexible Gradle-based picking system;

– fast and multifunctional emulator;

– the only environment that allows you to develop applications for all Android devices;

– instant launch to make changes to a running application without creating a new APK;

– code templates and integration with version control systems;

– a wide range of testing tools and tools;

– tools to track performance, usability, version compatibility, and other issues.

2.4Choosing software design patterns

A design pattern or pattern in software development is a repetitive architectural design that is a solution to a design problem within a common context.

Typically, a pattern is not a finished pattern that can be directly converted to code. This is just a sample solution to a task that can be used in a variety of situations. Object-oriented patterns show relationships and interactions between classes or objects without determining which end classes and application objects will be used.

"Low-level" patterns that take into account the specifics of a particular language are called idioms. These are good design solutions that are specific to a particular language or software platform and are therefore not versatile.

At the highest level, there are architectural patterns, they cover the architecture of the entire software system [44].

2.4.1 Choosing an architectural design pattern

The main architectural design patterns used in developing applications for the Android operating system include:

– Model-View-Controller (MVC);

– Model-View-Presenter (MVP);

– Model-View-ViewModel (MVVM).

The best approaches for organizing Android applications have evolved over the last few years. Developers have largely abandoned the outdated MVC model in favor of the more modular and easier to test MVP and MVVM.

The MVP pattern is a descendant of the MVC architecture. It consists of a clear division of the application into three levels (Figure 2.1).

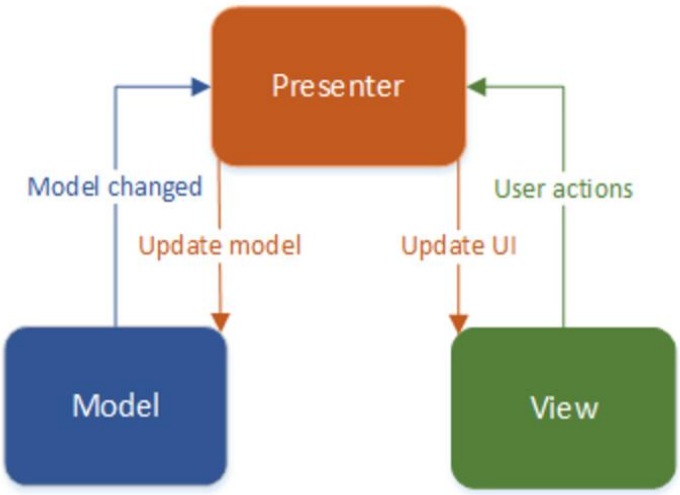


Figure2.1 – Features of MVP model components

Model contains all the business logic of the application, and also, if necessary, retrieves data from the repository.

The View is responsible for visually displaying the application and the user's command. It does not contain logic; it only notifies the Presenter about the user's actions.

The presenter is the interface between the Model and the Presentation. It is responsible for exchanging data between these components. This division allows you to replace parts of the code, perform the testing properly at each level

individually, and link the levels based on interfaces.

This approach has both strengths and weaknesses.

The disadvantages include:

– a large number of interfaces for interaction between levels;

– since each interface involves interaction with the smallest details, it can lead to many methods;

– code redundancy.

On the other hand, the advantages offset these disadvantages:

– presentation is responsible for visualization only, making it easy to understand and easy to maintain;

– better testing capabilities (when business logic is separated from the interface, you can test these components separately);

you can easily change the structure because all the interaction is built on interfaces.

MVVM is convenient to use instead of the classic MVC and the like when there is a "data link" in the platform under development (Figure 2.2). In MVC / MVP design templates, changes to the user interface do not directly affect the Model, but are previously made through the Controller or Presenter. Android provides DataBinding technology that allows you to bind data to visual elements in both directions. Therefore, when using this technique, the MVC model becomes extremely inconvenient because the binding of the data to the direction representation does not fit into the MVC / MVP concept.

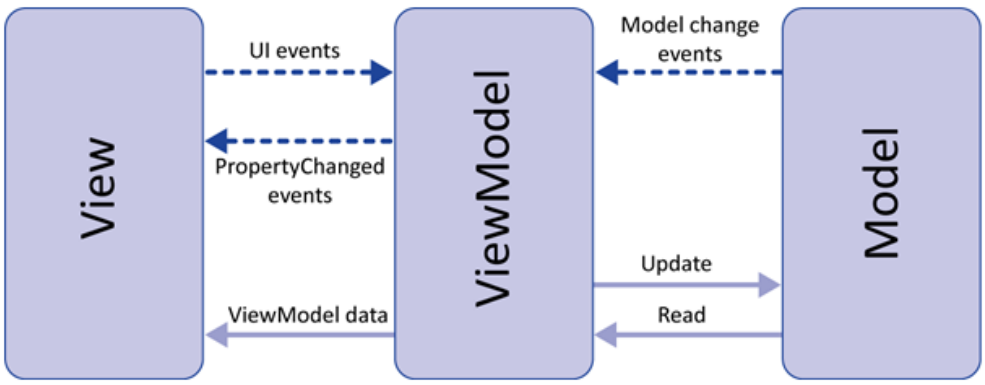


Figure 2.2 – Features of MVVM model components

In this case, the model, just like in the classic MVC, represents the business logic and fundamental data needed to run the application.

The view is a graphical interface. The view subscribes to events that change the values of the properties or commands provided to the View Model. In the event that a View Model has changed any property, it notifies all subscribers of this and the View, in turn, requests the updated property value from the View Model. In the event that the user affects any element of the interface, the View invokes the appropriate command provided by the View Model.

The View Model is, on the one hand, an Abstraction of the View, and on the other, a wrapper of data from the Models to be linked. That is, it contains a Model that has been converted to a View and also contains commands that can be used by the View to influence the Model.

Disadvantages of MVVM pattern:

– some parts of the code are XML related, making it difficult to debug and develop;

– testing is difficult.

At the same time, this approach has strong advantages:

– use the official Google library;

– review at compilation stage;

– view code simplification [45].

Based on the above information, the Model-View-Presenter architectural design template was selected for development. This is due to the fact that in the case of MVVM and, consequently, Android Data Binding, some of the application logic is transferred to markup files, which makes it difficult to understand the code.

2.4.2 Using the “Repository”pattern

One of the most commonly used patterns when working with data is the Repository pattern. The repository lets you abstract from the specific connections to the data sources that the program works with, and is an interface between classes that interact directly with the data and the rest of the program.

The repository template is a concept of storing a collection for entities of a certain type.

A repository is a collection that contains entities and can filter and return the result depending on the requirements of your application. It does not describe database storage or caching or any other technical issue. Repositories represent collections. How you store these collections is simply an implementation detail.

Let us have one connection to the MS SQL Server database. However, what if at some point in time we want to change the connection from MS SQL to another - for example, to MySQL or MongoDB database? With the standard approach, even in a small application that fetches, adds, changes and deletes data, we would have to make a lot of changes. In addition, there are times when we want to use two different connections depending on different conditions. Thus, the repository gives the program flexibility in working with different types of connections [46].

2.4.3 Inversion of Control and Dependency Injection

Inversion of Control is a principle of building programs in which its components receive a stream of control (called) from a shared library.

Control inversion as a dependency inversion principle is among the five SOLID principles.

For example, in the case of traditional programming, the main function of the program may call a function from the library to display a list of available commands and invite the user to select one of them. The library returns the selected option as a result of a function call. This style was used in text interfaces.

For example, a mail client might show a command screen to load new emails, reply to a current email, start a new email, etc., and block the application until the user presses a key to select a command.

Instead, in the case of control inversion, the program is written using a software framework that knows common behavioral and graphical elements such as window interface, menus, mouse controls, and more. Custom code "fills in the gaps" in the frame. In the example of a mail client, the framework can monitor the keyboard and the mouse and call the command selected by the user, while also monitoring the network interface to reflect the appearance of a new message and refresh the screen when network activity occurs. The same frame can be used as a skeleton for a spreadsheet program or text editor. On the other hand, the framework knows nothing about web browsers, spreadsheets, text editors - custom code is the embodiment of their functionality.

Management inversion carries the important idea that reusable code and task-dependent code are developed independently, although they work together.

The principle of dependency inversion is that upper level modules should not depend on lower level modules. Both types of modules must depend on abstractions. Abstractions should not depend on details. The details should depend on the abstractions [47].

One of the implementations of control inversion is Dependency Injection, which is used in many frameworks, including the Android platform.

Dependency injection is a software design pattern that provides external dependency to a software component using control inversion to resolve dependencies.

Deployment is the transfer of dependency (service) to a dependent entity (client). The fundamental requirement of this design pattern is to pass dependencies to the client instead of allowing them to create dependencies on their own.

There are three common forms of dependency injection:

– injectioninto the constructor;

– injectioninto the property;

– injection into the method.

The pattern separates the creation of client dependencies from its own logic, allowing the components to be loosely coupled and adhere to the principles of dependency inversion and single duty.

Using this pattern offers the following benefits:

– since dependency injection requires no change in code behavior, it can be used as refactoring. As a result, clients become more independent and easier to carry out unit testing in isolation using object layouts that mimic the other objects that the object being tested depends on. Testing simplicity is often the first notable benefit of using dependency implementation;

– dependency injection does not require the client to know the specific implementation that he or she needs to use. This allows you to isolate the client from the effects of design changes and defects. It facilitates code reuse, testing and maintenance;

– dependency injection can be used to migrate system configuration details to configuration files, allowing the system to change configuration without recompiling. Individual configurations can be written for different situations that require different implementations of components;

– dependency injection facilitates parallel and independent development. Two developers can independently create classes that use each other, knowing only the interfaces through which the classes collaborate;

– deployment reduces the relationship between a class and its dependencies [48].

2.5SQLite Database

SQLite is a compact, built-in relational database. The word "embedded" means that SQLite does not use the client-server paradigm, that is, the SQLite

kernel is not a separate working process with which the program interacts, but is a library with which the program is made and the kernel becomes part of the program. Thus, the SQLite library's function calls (APIs) are used as the exchange protocol. This approach reduces costs, response time and simplifies the program.

SQLite stores the entire database (including definitions, tables, indexes, and data) in a single standard file on the computer running the program. The database file format is cross-platform - you can freely copy a database between 32-bit and 64-bit systems.

Multiple processes or streams can read data from one database at a time without any problems. Recording to the database can be made only in the case when no other requests are currently served, otherwise the attempt to write fails and the error code returns. Another development is the automatic retry of recording attempts within a specified time interval.

Due to its architecture, SQLite can be used on both embedded systems and dedicated machines with gigabytes of data.

SQLite supports dynamic data typing. Possible field types: INTEGER, REAL, TEXT, BLOB.

The library code is public and thus free of charge for both private and commercial use [49].

SQLite is a compact library. If all features are enabled, the library size may not exceed 500 KB (depending on the target platform and compiler optimization options). If optional features are omitted, the size of the SQLite library can be reduced to 300 KB.

SQLite is thoroughly tested before every release and has the reputation of being a very reliable library. Most SQLite updates are dedicated to testing and validation only. The automated test suite contains millions of tests that include hundreds of millions of individual SQL messages and provides 100% code coverage.

The SQLite codebase is supported by an international team of developers working on the library full time. Developers continue to extend SQLite's

capabilities and increase its reliability and performance while maintaining backward compatibility with published interface specifications, SQL syntax, and database format [50].

The SQLite library comes with every Android application built in, so we'll use it.

2.6REST-client Retrofit 2.0 for Android

Retrofit is a REST client for Android and Java. It makes it relatively easy to send and receive JSON (or any other structured data) through a REST-based web service. Retrofit allows you to configure the converter for data serialization. Usually Gson is used, but you can create your own converters to handle XML or other protocols.

Retrofit uses the OkHttp library for HTTP requests.

To work with Retrofit you need to create three key entities:клас моделі, який використовується перетворення даних в та з JSON;

– an interface that identifies possible HTTP operations;

– Retrofit.Builder class is an instance that uses an interface and a Builder API to determine the destination URL for an HTTP operation.

Each interface method represents one possible API call. It should be marked with an HTTP annotation (GET, POST, etc.) to determine the type of request and the relative URL. The return value is a response wrapper in a Call object with the expected result type:

```
GET("users")
Call<List<User>>getUsers()
```

You can use the replacement blocks and query parameters to customize the URL.

The placeholder is added to the relative URL by {}. Using the @Path

annotation before a method input parameter, the value of this parameter is associated with a specific replacement unit:

```
@GET("users/{name}/commits")
Call<List<Commit>> getCommitsByName(@Path("name") String name)
```

Query parameters are added using the @Query annotation before the method parameter. They are automatically appended to the end of the URL:

```
@GET("users")
Call<User> getUserById(@Query("id") Integer id)
```

The @Body abstract before the method parameter tells Retrofit that the object should be used as the body of the call request:

```
@POST("users")
Call<User>postUser(@Body User user)
```

Retrofit can be configured to use a specific converter. This converter controls the serialization / deserialization of data. There is a set of commonly used converters for different serialization formats (Gson, Jackson, Moshi, Protobuf, Wire, Simple XML). In addition, power converters can be created to handle other protocols.

Retrofit supports API calls that require authentication. Authentication can be accomplished using a combination of a user name and password (HTTP Basic authentication) or an API token.

There are two approaches to implementing authentication.

The first way is to manipulate the request header with annotations. Yes, you need to request information about your user that requires authentication. You can do this by adding a new parameter to the API definition:

```
@GET("user")
Call<UserDetails>
getUserDetails(@Header("Authorization")            String
credentials)
```

With the @Header annotation (“Authorization”), you can force Retrofit to add an “Authorization” field to the request header with a value contained in the “credentials” variable.

To create Basic (Basic) credentials for authentication, you can use the OkHttp Credentials class with the basic (String, String) method. This method takes the username and password and returns the authentication account for the Basic scheme:

```
Credentials.basic("ausername","apassword");
```

The above method adds credentials only when prompted for user information. If you need to use multiple calls that require authentication, an interceptor should be used. The interceptor is used to modify each request before executing it and change the request header. The advantage of this approach is that there is no need to add an @Header annotation (“Authorization”) to each API method definition:

```
OkHttpClientokHttpClient = new
OkHttpClient().newBuilder().addInterceptor(new Interceptor() {
            @Override
            public okhttp3.Response intercept(Chain chain) throws
IOException {
                Request originalRequest = chain.request();

                Request.Builder builder =
originalRequest.newBuilder().header("Authorization",
                        Credentials.basic("aUsername", "aPassword"));

                Request newRequest = builder.build();
                return chain.proceed(newRequest);
            }
        }).build();
```

The OkHttp client created must be added to the Retrofit client using the client (OkHttpClient) method [51]:

```
Retrofit retrofit = new Retrofit.Builder()
.baseUrl("https://api.example.com")
.client(okHttpClient)
.build();
```

3 DEVELOPMENT OF THE MOBILE APPLICATION

3.1 Designing of the application

Consider the “Learning new words” use case:

a) user chooses a category of words;

b) systemdisplaysthelistofsubcategoriesfor theselectedcategory;

c) userchoosesasubcategoryof words;

d) system opens the subcategory screen;

e) user presses the«Manual» or «Slideshow» button;

f) system displays a list of words with pictures and pronunciation.

Consider the «Fulfillment of tasks» use case:

a) user chooses a category of words;

b) systemdisplaysthelistofsubcategoriesfor theselectedcategory;

c) userchoosesasubcategoryof words;

d) system opens the subcategory screen;

e) user presses the task button;

f) system displays the steps of the task;

g) user performs the task;

h) system displays a message about the correct or incorrect result.

Consider the «Playlists creating » use case:

a) user selectes «Playlists» item from the side menu;

b) system open a list of created playlists;

c) user presses the «Add playlist» button;

d) system displays a list of downloaded subcategories;

e) user selects two or more subcategories, enters the playlist name and presses the “Create” button;

f) system creates the playlist and displays a list of playlists.

3.2 Development of the database structure

Twodatabase tables should be created for the application to be developed: table“categories” contains information about categories and sub-categories of learning words (each category and subcategory represents a specific topic that groups the words into), table “words” contains a list of words to learn.

Let's take a closer look at the“categories” table fields:

– id – Integer – unique category or subcategory identifier;

– parent_id – Integer – unique category ID to which the subcategory belongs. This field is blank for categories;

– caption – String – the name of the category or subcategory;

– img_file_path – String –the path to an image related to a category or subcategory;

– download_state – Integer – download status of subcategory. Is presented with an enumeration with the following values: UNKNOWN, NOT_LOADED, LOADED, LOADING;

– language – String – category language;

Let's take a closer look at the“words” table fields:

– id – Integer – unique word identifier;

– category_id – Integer – the unique identifier of the subcategory to which the word belongs;

– caption – String – a word to study;

– pronunciation – String – transcription of the word;

– img_file_path – String –the path to the image related to the word;

– sound_file_path – String – the path to the audio file of the pronunciation related to the word;

– language – String – word language.

TheER-diagram of the database is shown in Figure 3.1.

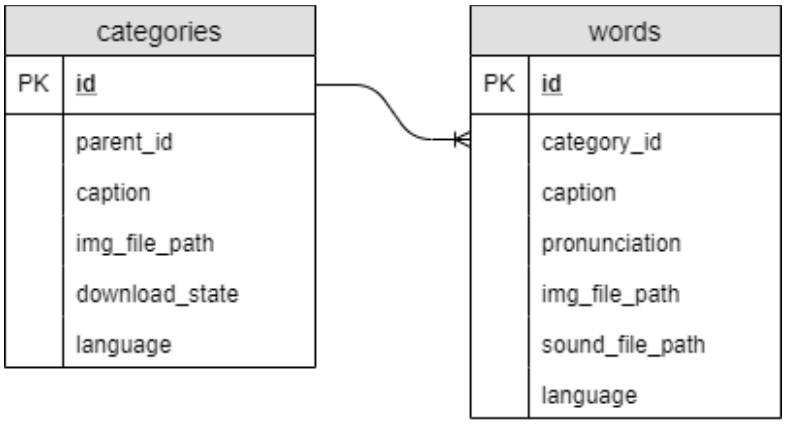


Figure 3.1 – TheER-diagramofthedatabasefor a developed mobile application

3.3 Instructionsand testing of the developed application

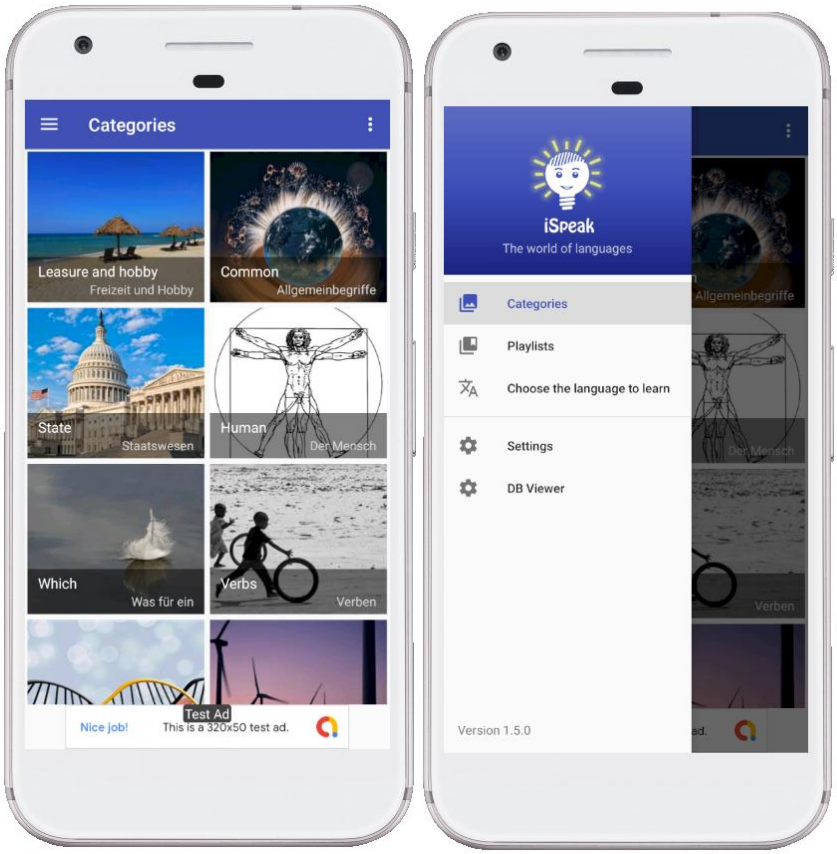
When you launch the applicationfor the first time, a screen with a list of learning languages opens (Figure 3.2).

Figure 3.2 – Screen with a list of languages to learn

Currently, the following languages are available for study:

– Chinese;
– English;
– German;
– Polish;
– Portuguese;
– Russian;
– Spanish;
– Ukrainian.

After selecting a language to learn, a list of word categories appears on the screen.Each category is a list of subcategories grouped by topic. From this screen you can also open a side menu containing the main navigation items (Figure 3.3).



a)b)

Figure 3.3 – Category selection screen: a) list of available categories; б) navigation menu

After selecting a category, a list of sub-categories of words appears on the screen (Figure 3.4). Each subcategory is a list of words to learn. After selecting a subcategory, the resources (words, images, and audio files) are loaded and the word learning screen opens.

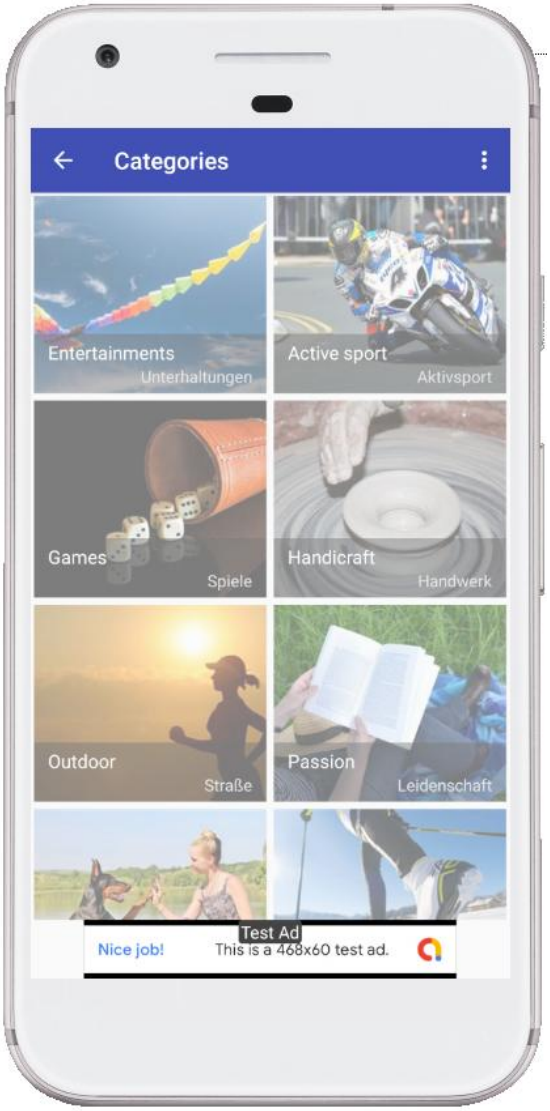


Figure 3.4 – Subcategory selection screen

The wordsstudy screen (Figure 3.5) gives the ability to view a list of words in a subcategory, associate each word with its translation, image and pronunciation, as well as consolidate knowledge through a variety of exercises.

Figure 3.5 – Wordsstudy screen

List of available exercises (Examples of exercises are shown in Figure 3.6.):

– one from two. The user is given a word and two images, one of which corresponds to the word. It is suggested to select an image that matches the word;

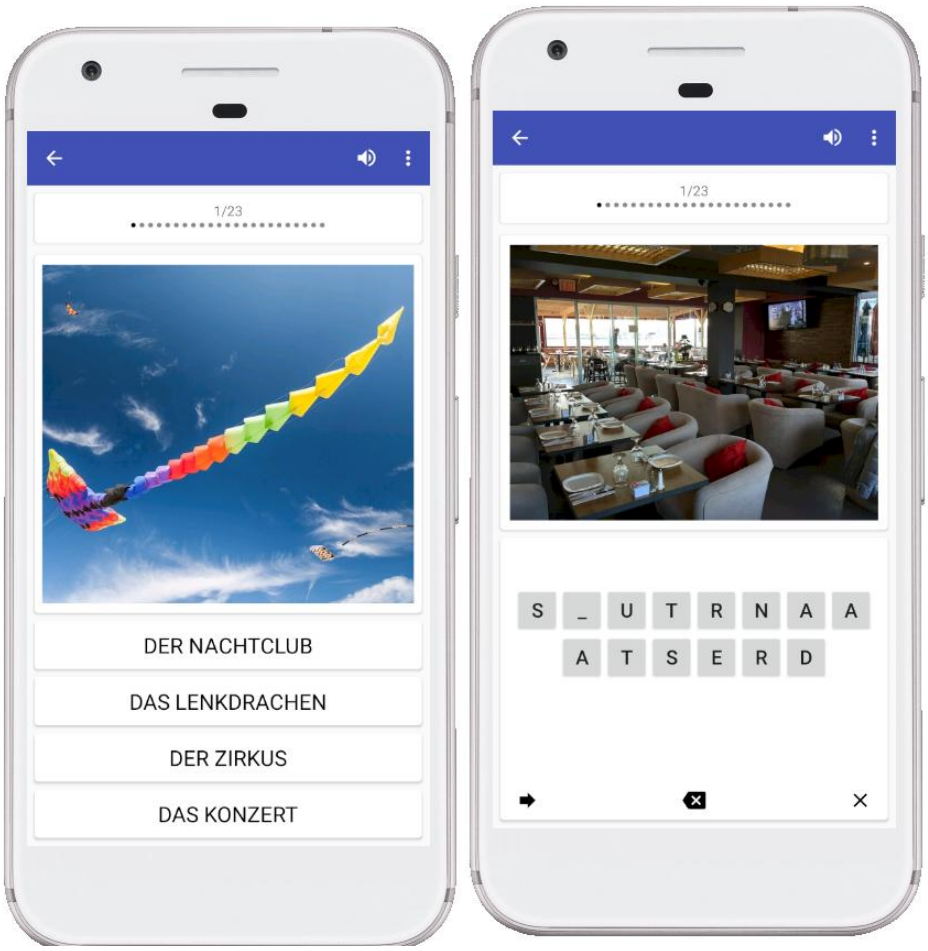
– onefromfour. The user is given a word and four images, one of which corresponds to the word. It is suggested to select an image that matches the word;

– one from four: text. The user is given an image and four words, one of which corresponds to the image. It is suggested to choose a word that matches the image;

– one froum four: listening. The user is given a pronunciation of a word and four images, one of which corresponds to the pronunciation. It is suggested to select the image that matches the pronunciation;

– true/false. The user is provided with a word and image.It is suggested to indicate whether the image corresponds to the given word;

– spell with picture. The user is provided with an image and a set of letters.It is suggested that the letters in question consist of a word that matches the image;



a) b)

Figure 3.6 – Exercise screen:

а) one from four: text;

б) spell with picture

– spell with voice. The user is given a pronunciation and a set of letters. It is suggested that the following letters be used to formulate a word that matches the pronunciation;

– translation – text. The user is given a word and four possible translations.

It is suggested to choose a translation that matches the word;

– translation – pronunciation. The user is given a pronunciation of the word and four possible translations. It is suggested to select a translation that matches the pronunciation;

– find pair – translation. The user is provided with four words and four translations.It is suggested to form a “word-translation” pair.

The settings screen is shown in Figure 3.7. It contains the following items:

– interface language;
– download using Wi-Fi only;
– playback order (constant or random);
– playback delay;
– number of playback cycles;
– enable/disable pronunciation;
– enable/disable translation.

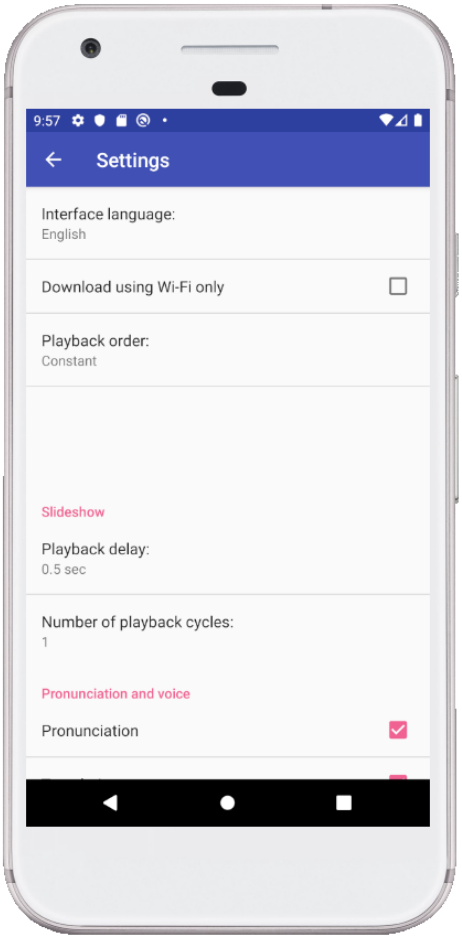


Figure 3.7 – Settings screen

4 DISTRIBUTION OF THE DEVELOPED MOBILE APPLICATION

Google Play is a digital distribution service created and maintained by Google. It is the official applications store for the Android OS. It allows users to find and download apps developed using the Android software development kit (SDK) and published via Google. It also functions as a digital media store, offering music, books, movies and TV programs.

Apps are available through Google Play either free of charge or at a cost. They can be downloaded directly on an Android devicethrough the Play Store mobile application or installed to a device via the Google Play website.Apps that use device hardware capabilities may target device users with certain hardware components, such as a motion sensor or a front-facing camera. The Google Play Store had over 82 billion applications downloads in 2016 and reached more than 3,5 million applications published in 2017[55].

Users in more than 145 countries can buy applications, althoughGoogle says on their support pages that “Paid content may not be available in some provinces or territories, even if the country is listed above”[56]. Developers in over 150 locations can distribute their applications on Google Play, though not every location supports seller registration. [57] Developers must pay a one-time $25 sign-up fee to distribute apps through the Google Play Developer Console account. [58]App developers can control which countries an app is distributed in, as well as the pricing for the app and in-app purchases in each country [59][60]. Developers get 70% of the cost of the app, and the rest 30% goes to the distribution partner and the operating fees [61]. Google Play allows developers to release early versions of applications for the selected user group as alpha or beta tests [62]. Developers can also release applications through step-by-step development, where “your upgrade reaches only the percentage of users, which you can increase over time” [63]. Users can pre-order selected applications for the products to be delivered as soon as they appear [64], Some network operators offer invoicing for purchases on Google Play, allowing users to choose to pay for their monthly bill by phone rather

than by credit card. Users may request a refund within 48 hours of purchase if "something you bought does not work, is not what you expected, was bought by accident, or you have changed your mind about buying" [65].

In addition to searching for content by name, applications can also be searched for keywords provided by the developer. While searching for apps, user can click on the suggested search filters to help them find application that match the determined filters. For the discoverability of applications, Play Store consists of lists of the most popular apps in each category, including:

– "Top Free", a list of the most popular free apps of all the time;

– "Top Paid", a list of the most popular paid apps of all time;

– "Top Gross", a list of applications that generate the highest amounts of revenue;

– "Trendy Apps", a list of applications with recent installation growth;

– "Top New Free", a list of the most popular new free applications;

– "Top New Paid", a list of the most popular new paid applications;

– "Featured", a list of new applications selected by the Google Play team;

– "Staff Picks", a list of updated applications that are frequently updated by the Google Play team;

– "Editor's Choice", a list of applications that are considered the best of all time;

– "Top Developer", a list of applications made by developers is considered the best [66]

Google Play lets users know the popularity of applications by showing the number of times the application has been downloaded. Download count are a color sign with special color markers to go over certain stages of app downloads, including gray for 100, 500, 1000 and 5000 downloads, blue for 10,000 and 50,000 downloads, green for 100,000 and 500,000 downloads and red/orange for 1 million, 5 million and 10 million and 1 billion downloads.

Users can submit reviews and ratings of programs and digital content

distributed through Google Play that are publicly displayed. Ratings are based on a 5-point scale. App developers can respond to reviews using the Google Play Developer Console [67].

Google at its Developer Policy Center states that “Google Play supports a variety of monetization strategies for the benefit of developers and users, including paid distribution, in-app products, subscriptions and advertising-based models”, and requires developers to adhere to “ensure the best user experience”. Developers charged for apps and downloads vid Google Play are required to use the Google Play payment system. In-app purchases to unlock additional app functionality must also use the Google Play payment system unless the purchase “is solely for physical products” or “digital content that can be consumed outside the app itself (for example, songs that can be played on other music players)”[68].

Google allows users to purchase content through credit or debit cards, carrier billing, gift cards or through PayPal [69].

Google places some restrictions on the types of apps that may be published, such as prohibiting sexual content, child endangerment, abuse, harassment, hate speech, gambling, illegal activity, and requiring precautionary measures against user-generated content [70].

CONCLUSIONS

This master's qualification work is devoted to the problem of introduction of modern information technologies into the process of learning foreign languages and replenishing the vocabulary of children. The use of information technologies in the process of learning, the process of learning foreign languages, the process of teaching children is analyzed.

Advantages and disadvantages of introduction of information technologies in the educational process are presented.Modern methods of replenishing the vocabulary of children are analyzed and compared.

An overview of modern services and tools for learning foreign languages and replenishing the vocabulary of children is provided.

The approaches and tools most relevant to the development of the Android mobile platform for this topic are analyzed and selected.

The mobile application for Android platform that allows to learn foreign languages (Ukrainian, Russian, English, German, Spanish, Portuguese and Chinese) and supplement children vocabularyhas been developed. The developed information system, unlike existing analogues, increases the efficiency of learning foreign languages and the vocabulary of children replenishment by using new highly effective means of learning, obtained by analyzing the most effective methods of language learning usednowdays

The application was developed using Android Studio using the Kotlin programming language.

The developed software was tested. Comparison of the results of its work with existing analogs makes it possible to conclude that the set tasks are fulfilled in full.

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67. View & analyze your app’s ratings & reviews[Electronic resource]: [Website] – Electronic data. – Access mode: https://support.google.com/googleplay/android-developer/answer/138230Screen name.

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69. Accepted payment methods on Google Play[Electronic resource]: [Website] – Electronic data. – Access mode: https://support.google.com/googleplay/answer/2651410 - Screen name.

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ATTACHMENTS

Attachment A (mandatory).Technical task

Vinnytsia National Technical University

APPROVED BY
Head of the department of the AIIT VNTU,
Dr.Sc., Prof
_____R. Kvetny
“__” _____ 2019

TECHNICAL TASK

For the master's qualification work

«Software for increasing the vocabulary of children and learning foreign languages. Part 2. Development of software for mobile devices»

08-02.MQW.011.00.000 TT

Supervisor of Masters Qualification work
Associate Professor of
the department of the AIIT
I.Bogach
“___” _____ 2019

Performer: st. of 3ACIT-18m group
Y. Opolskyi
“___” _____ 2019

Vinnytsia 2019

1.Name and field of application

1.1. Title –«Software for increasing the vocabulary of children and learning foreign languages. Part 2. Development of software for mobile devices»

1.2. Field of application – Educational information systems.

2. The basis for the development.

Theme of master's qualification was approved by order VNTU № ____ from "_____”

3. Purpose and designation.

The purpose of master's thesis is to create a new information system for learning foreign languages and replenishing the vocabulary of children using new highly effective learning tools.

4. Initial data for development.

Master's qualification work is carried out for the first time. During the development, the following documents should be used:

1. Красовская Л.В., Исабекова Т.И. Использование информационных технологий в образовании. Научный результат. Педагогика и психология образования – Том 3, Выпуск №4 – 2017

2. Belz J.A., Thorne S.L. Computer-mediated Intercultural Foreign Language Education. − Boston, MA: Heinle & Heinle, 2010.

3. Thorne S.L., Black R. Language and Literacy Development in Computer-mediated Contexts and Communities // Annual Review of Applied Linguistics. − 2008. − № 28.

5. Requirements for development.

5.1. List of main features:

- User authorization;
- Support the following languages to learn: Chinese, English, German, Polish, Portuguese, Russian, Spanish,Ukrainian;
- Ability to group lessons into categories and subcategories;
- Ability to learn words using visual and auditory perception;
- Set of exercises to consolidate the learned words;

5.2. Basic technical requirements for development.

5.2.1. Requirements for the software platform: Android.

5.2.2. Operating system conditions:

- work on mobile devices based on Android 5.0 or higher;
- the possibility of a 24-hour system operation.

6. Stages and stages of development.

6.1 Explanatory note:

1	Analysis of the current state of the problem of introduction of information technologies into the learning process	
2	Analysis of methods of learning foreign languages and replenishing the vocabulary of children, conducting their comparative analysis, determining their advantages and disadvantages.	
3	Designing an information system for learning foreign languages and replenishing the vocabulary of children	
4	Researching modern approaches and technologies that can be used in the development of an information system	
5	Practical implementation and analysis of the results	
6	Approval of research results	
7	Publications	
8	Designing an explanatory note, graphic material and presentation	
9	Master’s work defense	

7. The order of control and acceptance.

7.1. The progress of master's qualification work is supervised by the head of the work. The border control should be conducted until _____.

7.2. The project certification is carried out on preliminary protection. Preliminary defense of master's qualification work is to be held until _____.

7.3. The final decision on the assessment of the quality of the master's qualification work is taken at a meeting of the DEC. The defense of master's qualification work is to hold _____.

Attachment B (mandatory).

List of graphical materials

Head of the department of the AIIT _____ Dr.Sc., Prof R. Kvetny

(signature) (*name, surname, degree, academic status*)

Scientific supervisor _____ PhD.,As.Prof I. Bogach

(signature) (*name, surname, degree, academic status*)

Technical control _____ PhD.,As.Prof I. Bogach

(signature) (*name, surname, degree, academic status*)

Regulatory control _____ PhD.,As.Prof I. Bogach

(signature) (*name, surname, degree, academic status*)

Reviewer _____ PhD.,As.Prof O. Nikitenko

(signature) (*name, surname, degree, academic status*)

Student of the 3ACIT-18m group _____ Y. Opolskyi

(signature) (*name,surname*)

The continuation of the attachment B

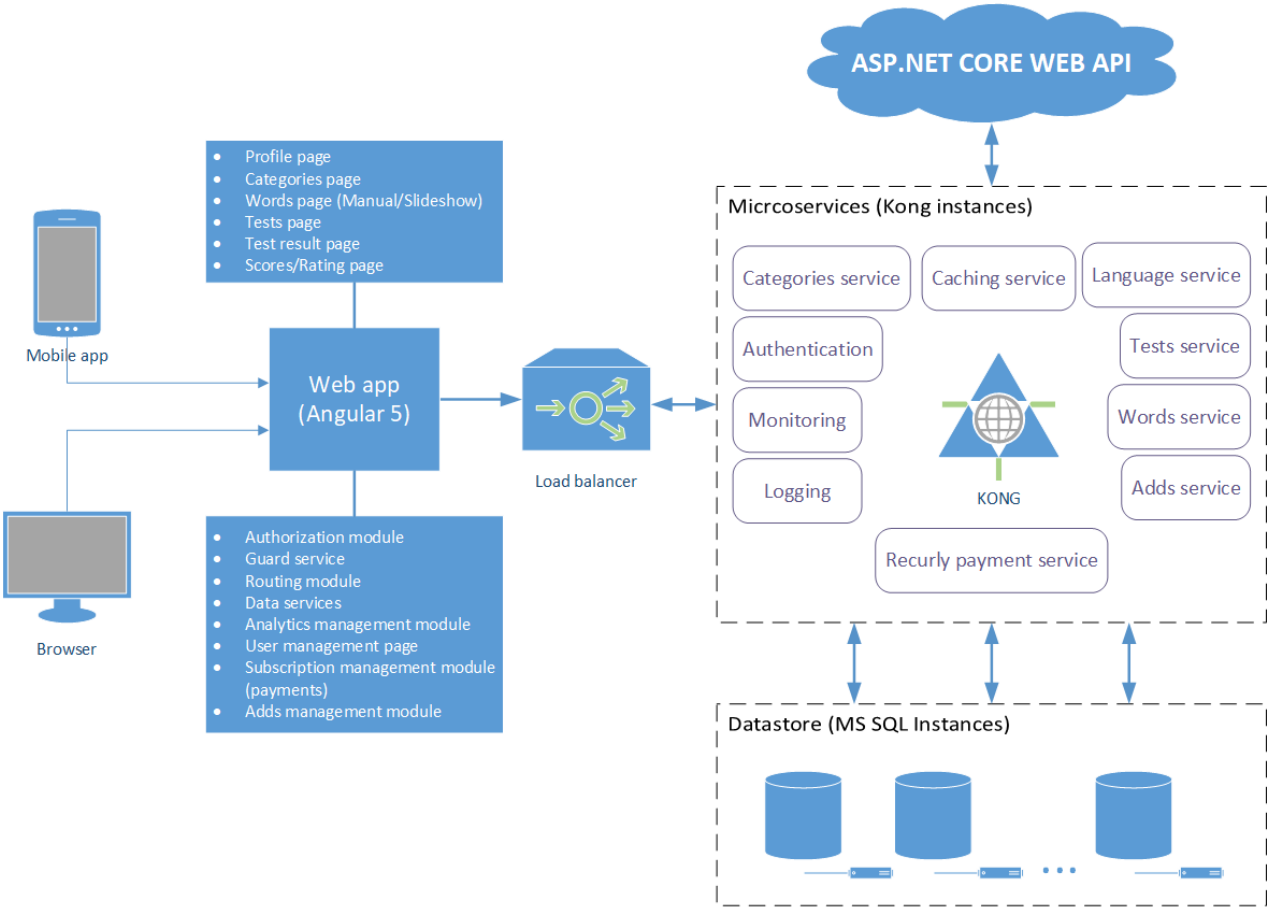


Figure B.1 – Client-server architecture of the developed information system

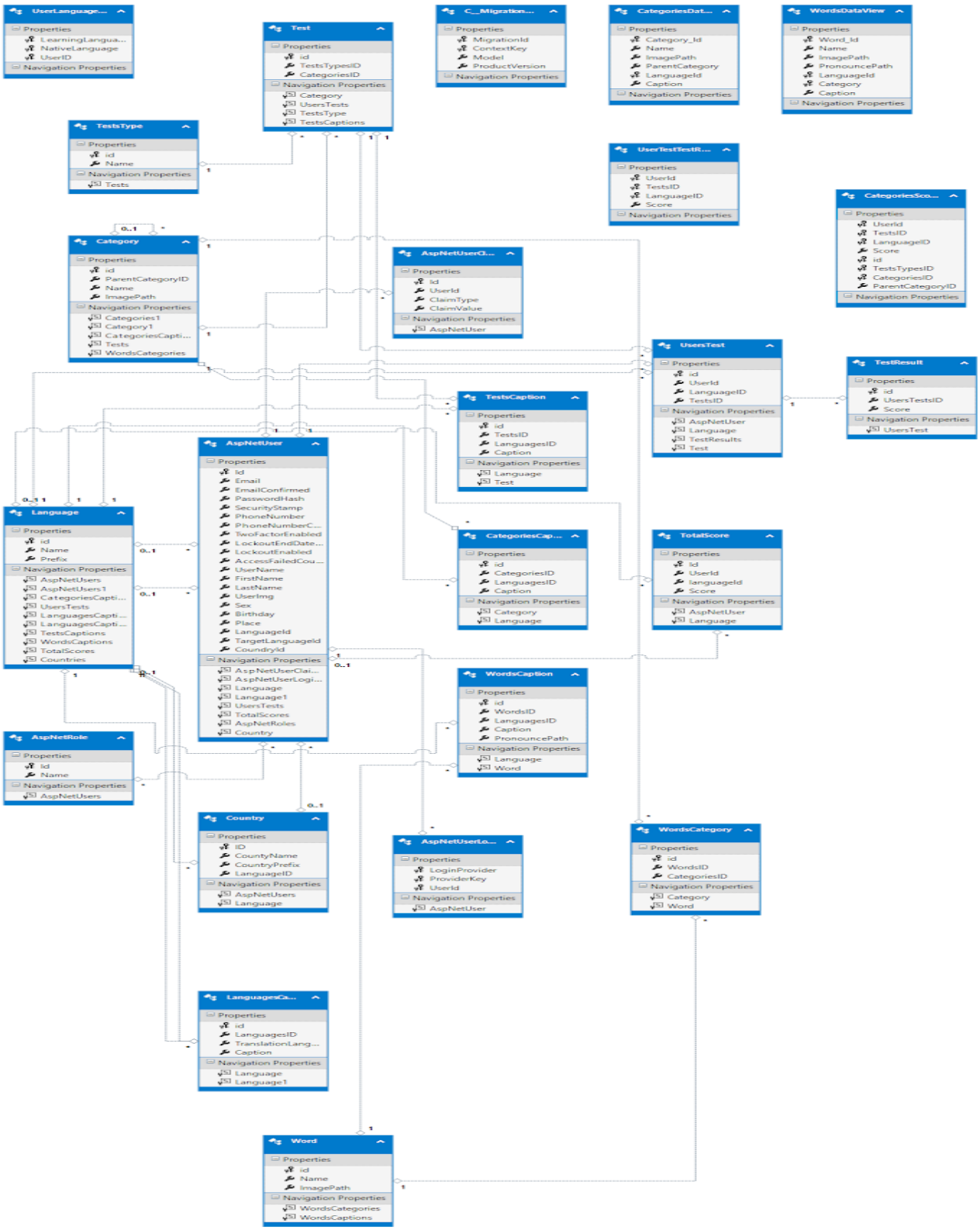
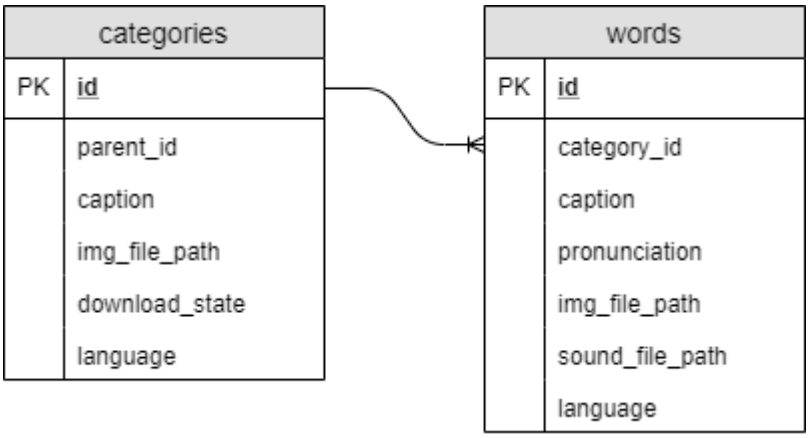


Figure B.2 – Backend database structure of the developed information system



FigureB.3 – TheER-diagramofthedatabasefor a developed mobile application

Figure B.4 – Use-case UML diagram of the developed information system

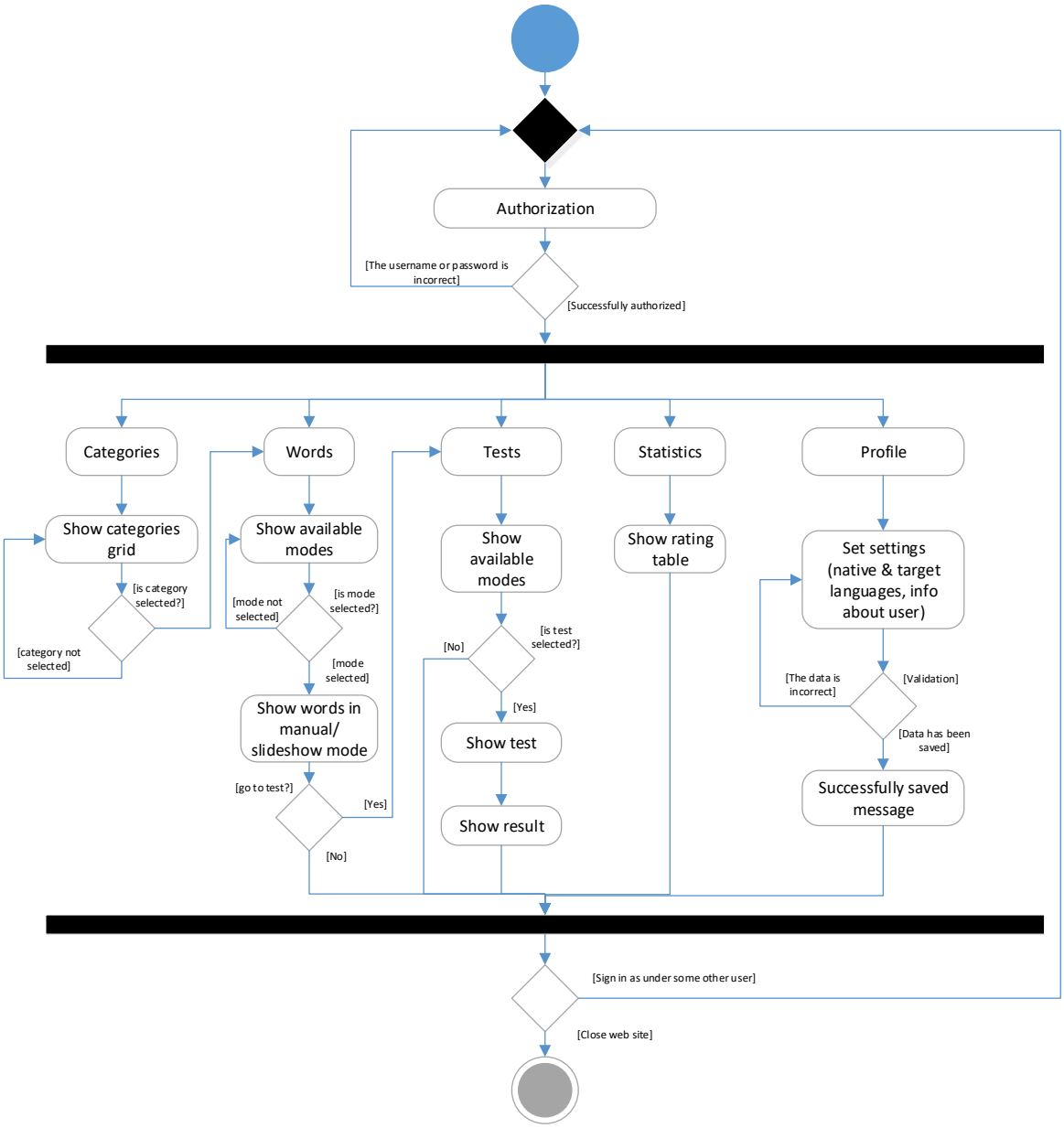


Figure B.5 – Activity UML diagram of the developed information system

Attachment C (mandatory).
Listing of the software

```
package com.fivesysdev.ispeak.upgrade.data

import android.text.TextUtils
import com.fivesysdev.ispeak.upgrade.data.local.database.MetaDatabase
import com.fivesysdev.ispeak.upgrade.data.model.Category
import com.fivesysdev.ispeak.upgrade.data.model.CategoryState
import com.fivesysdev.ispeak.upgrade.data.model.JsonPath
import com.fivesysdev.ispeak.upgrade.data.model.Word
import com.fivesysdev.ispeak.upgrade.data.remote.MetaDataApi
import com.fivesysdev.ispeak.upgrade.data.remote.responses.CategoriesResponse
importcom.fivesysdev.ispeak.upgrade.utils.CategoryUtils
import com.fivesysdev.ispeak.upgrade.utils.JSON_DIR
import com.google.gson.GsonBuilder
import dagger.android.support.DaggerApplication
import io.reactivex.Flowable
import timber.log.Timber
import java.io.BufferedReader
import java.io.File
import javax.inject.Inject

class MetaDataRepository @Inject constructor(private val application:
DaggerApplication, private valmetaDataApi: MetaDataApi, private valmetaDatabase:
MetaDatabase) {

valgson = GsonBuilder().setPrettyPrinting().create()!!

    /* region Public */
    fun loadCategoriesByParentCategoryId(parentCategoryId: Int, language: String):
Flowable<List<Category>> {
Timber.d("loadCategoriesByParentCategoryId(parentCategoryId: $parentCategoryId,
language: $language)")
        return loadCategoriesLocalByParentCategoryId(parentCategoryId, language)
                .flatMap { dbResult ->
                    if (dbResult.isEmpty())
readCategoriesFromFile(getCategoryFileName(parentCategoryId, language))
                                .flatMap { it ->
                                    if (it.isEmpty()) {
```

```
Timber.d("loadCategoriesByParentCategoryId(parentCategoryId: $parentCategoryId,
language: $language) empty file result")
loadCategoriesRemoteByParentCategoryId(parentCategoryId, language)
                                    } else {
Timber.d("loadCategoriesByParentCategoryId(parentCategoryId: $parentCategoryId,
language: $language) $it")
Flowable.just(it)
                                    }
                                }
                    else
Flowable.just(dbResult)
                }
    }

    fun loadWordsByCategoryId(categoryId: Int, language: String):
Flowable<List<Word>> {
Timber.d("loadWordsByCategoryId(categoryId: $categoryId, language: $language)")
        return loadWordsLocalByCategoryId(categoryId, language)
                .flatMap { dbResult: List<Word> ->
                    if (dbResult.isEmpty())
readWordsFromFile(getWordsFileName(categoryId, language))
                                .flatMap { it ->
                                    if (it.isEmpty())
loadWordsRemoteByParentCategoryId(categoryId, language)
                                    else
Flowable.just(it)
                                }
                    else
Flowable.just(dbResult)
                }
    }

    /* endregion */

    /* region DB */
    private fun loadCategoriesLocalByParentCategoryId(parentCategoryId: Int,
language: String): Flowable<List<Category>> {
        Timber.d("loadCategoriesLocalByParentCategoryId(parentCategoryId:
$parentCategoryId, language: $language)")
        return Flowable.fromCallable {
metaDatabase.categoryDao().getSubCategoriesByParentId(parentCategoryId, language) }
```

```
    }

    private fun saveCategoriesLocal(categories: List<Category>) {
Timber.d("saveCategoriesLocal(categories: $categories)")
metaDatabase.categoryDao().insertAll(categories)
    }

    private fun loadWordsLocalByCategoryId(categoryId: Int, language: String):
Flowable<List<Word>> {
Timber.d("loadWordsLocalByCategoryId(parentCategoryId: $categoryId, language:
$language)")
        return Flowable.fromCallable { metaDatabase.wordDao().getWords(categoryId,
language) }
    }

    private fun saveWordsLocal(words: List<Word>) {
Timber.d("saveWordsLocal(categories: $words)")
metaDatabase.wordDao().insertAll(words)
    }
    /* endregion */

    // region Network
    private fun loadCategoriesRemoteByParentCategoryId(parentCategoryId: Int,
language: String): Flowable<List<Category>> {
        Timber.d("loadCategoriesRemoteByParentCategoryId(parentCategoryId:
$parentCategoryId, language: $language)")
        return metaDataApi.getCategoriesList(parentCategoryId.toString(), language)
                .retry(3)
                .flatMap { result ->
vallistIds: String = TextUtils.join(",", result.categoryIds).replace("\\s", "")
                    if (listIds.isNotEmpty()) {
metaDataApi.getCategoriesDetails(listIds, language)
                    } else {
Flowable.empty<CategoriesResponse>()
                    }
                }
                .doOnNext { result ->Timber.d(result.toString()) }
                .flatMap { categoriesResponse ->
Flowable.fromIterable(categoriesResponse.categories)
                }
                .map { it: Category ->
```

```
it.apply {
it.language = language
it.state = CategoryState.UNKNOWN
it.isHidden = CategoryUtils.isCategoryHidden(it.id)
it.sortOrder = CategoryUtils.getCategorySortOrder(it.id)
                    }
                }
                .toList()
                .toFlowable()
                .doOnNext { categories ->
saveCategoriesLocal(categories)
                }
    }

    private fun loadWordsRemoteByParentCategoryId(categoryId: Int, language: String):
Flowable<List<Word>> {
Timber.d("loadWordsRemoteByParentCategoryId(categoryId: $categoryId, language:
$language)")

        return metaDataApi.getWordsDetails(categoryId.toString(), language)
                .retry(3)
                .doOnNext { result ->Timber.d(result.toString()) }
                .flatMap { wordsResponse ->
Flowable.fromIterable(wordsResponse.words)
                }
                .map { it: Word ->
it.apply {
it.language = language
                    }
                }
                .toList()
                .toFlowable()
                .doOnNext { words ->
saveWordsLocal(words)
                }
    }
    // endregion

    // region FileStore
    private fun readCategoriesFromFile(fileName: JsonPath): Flowable<List<Category>>
{
```

```
Timber.d("readCategoriesFromFile(fileName: $fileName)")
        return try {
valjsonFile = application.assets.open(fileName.toString())
valbufferedReader: BufferedReader = jsonFile.bufferedReader()
valinputString = bufferedReader.use { it.readText() }
val categories: List<Category> = gson.fromJson(inputString,
Array<Category>::class.java).toList()
saveCategoriesLocal(categories)
Flowable.just(categories)
        } catch (e: Exception) {
Timber.e("readCategoriesFromFile(fileName: $fileName) File not found")
Flowable.empty<List<Category>>()
        }
    }

    private fun readWordsFromFile(fileName: JsonPath): Flowable<List<Word>> {
Timber.d("readWordsFromFile(fileName: $fileName)")
        return try {
valjsonFile = application.assets.open(fileName.toString())
valbufferedReader: BufferedReader = jsonFile.bufferedReader()
valinputString = bufferedReader.use { it.readText() }
val words: List<Word> = gson.fromJson(inputString, Array<Word>::class.java).toList()
saveWordsLocal(words)
Flowable.just(words)
        } catch (e: Exception) {
Timber.d("readWordsFromFile(fileName: $fileName) File not found")
Flowable.empty<List<Word>>()
        }
    }
    // endregion

    /* region fileNames */
    private fun getCategoryFileName(categoryId: Int, language: String): JsonPath {
val result = getFileName(categoryId, language, true)
Timber.d("getCategoryFileName result $result")
        return result
    }

    private fun getWordsFileName(categoryId: Int, language: String): JsonPath {
val result = getFileName(categoryId, language, false)
Timber.d("getWordsFileName result $result")
```

```
        return result
    }

    private fun getFileName(categoryId: Int, language: String, isCategory: Boolean):
JsonPath {
val folder = JSON_DIR + language + File.separator
valfileName = when (isCategory) {
            true -> "category_" + (if (categoryId == -1) "root" else categoryId) +
"_" + language + ".json"
            false -> "words_" + categoryId + "_" + language + ".json"
        }
        return JsonPath(folder, fileName)
    }

    /* endregion */

}
```