

Andrioid mobile application aimed at getting personalized recommendations when selecting references

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Abstract. This article presents the results of the development of a mobile recommendation application to help library readers select references. One of the tasks of a librarian is to provide consultative assistance to the reader in selecting books. Working with a librarian can be replaced by the use of electronic library systems or special programs, which will allow you to solve the same task in less time. At the moment, there are websites and digital libraries that help the user to select books for further reading. They implement various algorithms that allow you to create personalized recommendations. Such systems are designed for electronic reading and are not linked to the databases of municipal library systems. Library readers can obtain recommendations when they choose literature for further reading using a mobile application. The paper considers the process of its creation: analysis of program requirements, design, implementation, testing and implementation. The application is developed for the Android operating system in the integrated development environment Android Studio in the Java programming language. The calculation of the technical and economic indicators of the project in its implementation has shown that the use of the application will provide sufficient economic effect. Its use can simplify the process of selecting books and significantly reduce the time to search for them, thus giving the librarian the opportunity to perform other tasks. The program does not require material costs for installation, which is an obvious advantage, and the functionality and system requirements allow its use on all mobile devices with the Android operating system.

1 Introduction

Modern information and library service is a complex process associated with the study of users' needs in order to meet them through the available information resources. The information function of the library nowadays includes the provision of information, books and documents from the library's collection, bibliographic information and counseling,

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promotion of books and reading in the reading environment, formation of the basics of information culture of users.

In this regard, one of the tasks of the librarian is to provide, if necessary, consultative assistance to the reader in the selection of books. For this purpose, his interests and the books he has already read are taken into account. On the basis of this information, the librarian selects the catalog literature recommended for reading. Working with a librarian in this direction can be replaced by the use of electronic library systems or special programs, which will solve the same problem in less time.

At the moment there are websites and electronic libraries that allow you to select books for further reading. They implement various algorithms that allow you to create personalized recommendations [1].

Such systems are designed for electronic reading and are in no way connected with catalogs of information resources of municipal library systems. In this regard, it is relevant to use a mobile application to receive personalized recommendations when library readers choose literature. The use of the program will simplify the process of book selection, thus giving the librarian the opportunity to perform other tasks.

2 Materials and Methods

The objective of this paper is to develop a mobile application for obtaining a list of recommended literature from the library collection. The work includes a detailed analysis of the subject area, selection of an algorithm for building recommendations based on the research of famous authors in this field, design and implementation of the application.

3 Results and Discussion

3.1 Analysis of the subject area

The main activity of libraries is the organization of library services to the population, acquisition and preservation of library funds. The library provides free access to various sources of information, keeps records of documents, collects, analyzes and processes statistical information, prepares methodological materials, provides consulting assistance in searching and selecting sources of information, selects literature for the user on an individual basis, issues library documents and their copies for temporary use, etc. The library provides free access to various sources of information.

To select literature or make an individual recommendation, which corresponds to the age group of the visitor and the sphere of interests, the library staff uses the data obtained from the reader's card. When providing counseling, the librarian uses various technical means that provide access to information about the reader and sources of information. This data is stored in the card index and can be used to improve the quality of service to the readers. As a result, the librarian is able to find a more appropriate recommendation for the reader.

To work with the card catalog, special software is used to retrieve information from the database "Irbis" and to issue books to readers in accordance with the rules of library use and based on the data recorded in the book form and reader's card. The search algorithm provides the ability to find publications by keywords, sorting the results in descending order of document rank, by author, title (if known) or year of publication.

To access the electronic database and various software, technical means are used, such as personal computers, document and image processing tools (printers, scanners), graphic

tablets, as well as devices for unimpeded access to literature for blind people, providing a comfortable environment for learning and development.

Computers are equipped with programs for processing images, editing documents, have access to the Internet and can be used by the reader to obtain information, as well as to search for documents and access to legal reference systems. If necessary, the user can display information on removable media for further work with it, print it out or send it by e-mail.

The main work is performed by the library staff, whose duties include both working with the card catalog and providing readers with access to literary editions, technical means, as well as issuing various information references, consultations and holding events.

To illustrate the organization of work of the municipal library, a context diagram in IDEF0 methodology is built (Fig 1).

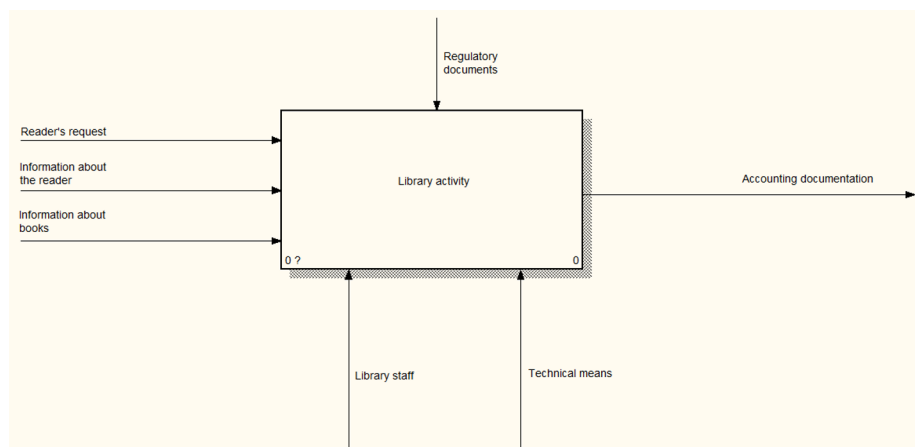


Fig. 1. Library activity context diagram (IDEF0 methodology)

The first stage of the decomposition (Fig. 2) shows the main functions of library activity: providing counseling services to readers, issuing books, conducting events, and generating reports. In order to issue a book to a reader, a library employee needs to know information about the reader and the books in the library, as well as to understand what kind of request comes from the reader. However, the reader does not always have a clear understanding of what exactly he/she wants to read, so he/she may need counseling to get a recommendation.

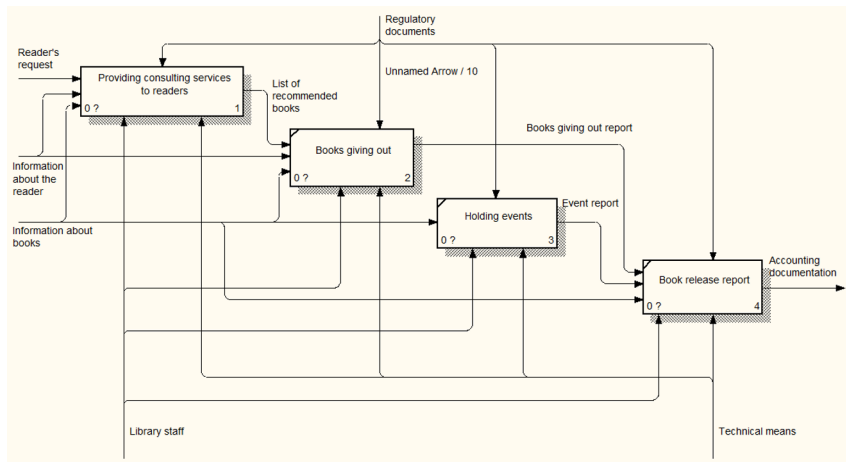


Fig. 2. First step of context diagram decomposition

Detailing in detail the essence of the process of providing consulting services, it is possible to distinguish several stages (Fig. 3).

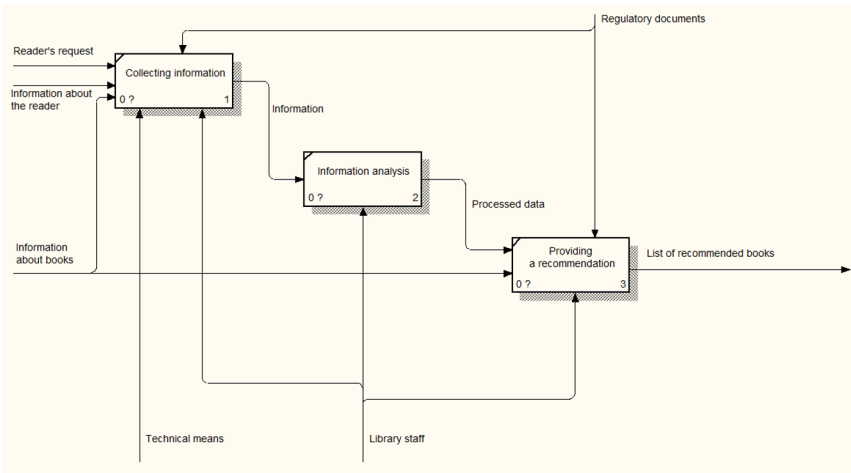


Fig. 3. Second step of context diagram decomposition

It is possible to simplify the process of librarians providing consultative assistance in finding and selecting sources of information. This can be done through the use of digital library systems or special programs, which will allow the reader to select the information source of interest in less time.

3.2 Review sites and apps for recommending books to read

Among the existing sites and applications that have the function of recommending literature, the following are highlighted:

- 1. Goodreads is one of the most popular book reading sites. It provides a platform where readers can rate and discuss books, make lists of books they have read and are interested in, and get recommendations based on their preferences. It offers personalized book recommendations based on users' preferences and ratings, and also allows users to view other users' book reviews.

2- LitRes is Russia's largest online e-bookstore, which has both a website and its own app for mobile devices. Thanks to an algorithm that analyzes user preferences, it is possible to get recommendations based on user preferences and book reading history. It is possible to view popular books, new releases and reviews from other users.

3. LiveLib is a social network for book lovers, where you can create interest groups, write reviews and discuss what you have read. Based on a user's preferences and reading history, LiveLib offers personalized book recommendations. The system takes into account the user's ratings, reviews, book lists and other data to suggest suitable books and authors.

4. ReadRate is an online service that offers, in addition to the ability to rate and discuss books, personalized recommendations based on the user's preferences and reading history. There is an opportunity to view lists of popular books and novelties.

Existing sites and digital libraries that allow selecting books for further reading are very convenient, but they are designed for e-reading and are not connected with traditional libraries, so they cannot provide information about the availability of literature of interest to the user. In this regard, it is relevant to create a mobile application for self-recommendation of books by library readers.

3.3 Algorithms for recommendation construction

There are different algorithms for constructing recommendations based on different approaches.

Collaborative filtering is based on the assumption that if two users have similar preferences in the past, they are likely to have similar preferences in the future. Collaborative filtering can be implemented using item-based or user-based methods. It allows making recommendations based on users' interactions with books (e.g., ratings, reviews, adding to favorites, etc.) [2]. This approach faces the problem of sparse dataset which reduces its performance, which can be solved by using probabilistic keyword model [3]. Increasing the performance of the algorithm can also be achieved by applying a group deep adversarial autoencoder. It allows combining the knowledge of different users for decision making, improving the efficiency of information fusion and the quality of group decision making [4].

The content filtering algorithm is based on analyzing the content of books and suggests books of similar genre, author, subject etc. to the user. Content filtering is independent of user interactions and can be useful when there is limited data about their evaluations and preferences.

Hybrid algorithms combine several approaches such as collaborative filtering and content filtering to achieve better performance. They can combine the advantages of different algorithms and offer more accurate and personalized recommendations [5, 6, 7, 8]. A hybrid model based on multi-objective optimization improves the reliability of recommendations by combining different underlying techniques to obtain them [9]. A multi-criteria evolutionary algorithm is applied to solve it. The joint application of collaborative filtering algorithm and decision tree construction can identify the rules of book suggestion to users and obtain a more accurate recommendation [10]. A multi-context algorithm based on knowledge graph can obtain recommendations with high accuracy and performance [11].

Neural networks can also be used to obtain recommendations. For example, a convolutional neural network integrated with a particle swarm optimization algorithm generates new relevant random recommendations that cannot be easily detected by users [12]. The application of deep neural networks provides an opportunity to increase the performance of recommendation algorithms [13].

Natural language processing models [14] and association rule mining [15] can also be applied to construct recommendations.

Since the mobile application under development should take into account the preferences of a single user, the content filtering algorithm, which has a number of advantages, is chosen to build recommendations in it:

1. Takes into account individual user preferences based on the analysis of book content and factors such as genre, author, subject, keywords and other characteristics. Therefore, it allows you to create personalized recommendations.

2. Does not depend on user interactions, so does not require a large amount of data.

The content filtering process typically involves the following steps:

1. recommendation elements are represented as a set of characteristics or attributes such as, for example, genre, author, author, keywords, rating, etc.

2. A user profile is built based on the user's previous actions or preferences.

3. For each recommendation item, its similarity to the user profile needs to be computed.

After calculating the similarity for all recommendation items, you can sort them by the degree of similarity to the user's preferences. Items with a higher degree of similarity are usually recommended first.

3.4 Mobile application design and implementation

The mobile application for recommending books to be read should be linked to the library database. In terms of interface, the following screens are required: the home screen, the screen for displaying the list of books read, and the screen for displaying the list of recommended books.

After launching the application on the main screen displays its name, buttons to go to the screens of read and recommended books. For all screens there is a possibility to return to the main screen and in each list there is a possibility to delete information about books from it.

The diagram of mobile application usage options describes the functionality of the program (Fig 4).

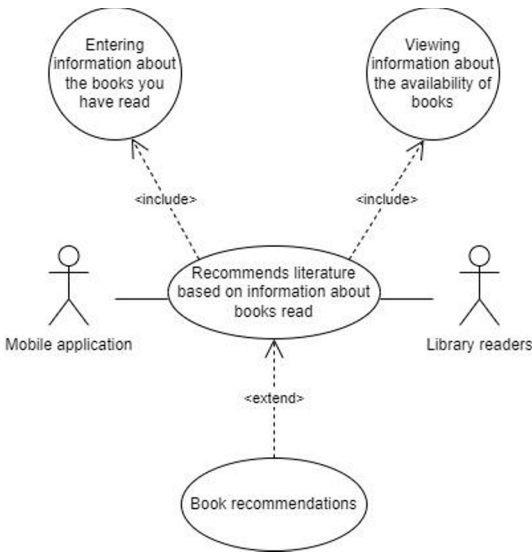


Fig. 4. Use case diagram

The elements of the use-cases diagram are connected by relations that characterize the nature of their influence on each other. After launching the application, the user can enter the title and author of the books read and view information about their availability in the library. As a result of filling in the list of books read by the user, the application will recommend literature to read based on this information.

The application should work on devices with API 32 (Sv2) running Android version 4.4 (KitKat) and 4.4W (KitKat Wear).

Android Studio as an integrated development environment (IDE) and Java programming language are chosen to develop the mobile application.

The implementation of the mobile application for recommending books to read is represented by the following sequence of actions:

- the library user provides the application with information about the books read;
- after receiving the necessary data, the application uses a content filtering algorithm to select a recommendation;
- the library user can view the recommendation suggested by the application.

As a result of analyzing the sequence of actions, the following entities are identified: library user, library database, mobile application. As data stores are defined: list of read books, list of recommended books.

Class diagram visualizes the classes of the project and the order of their relationship with each other in the mobile application for recommending books to read (Fig. 5).

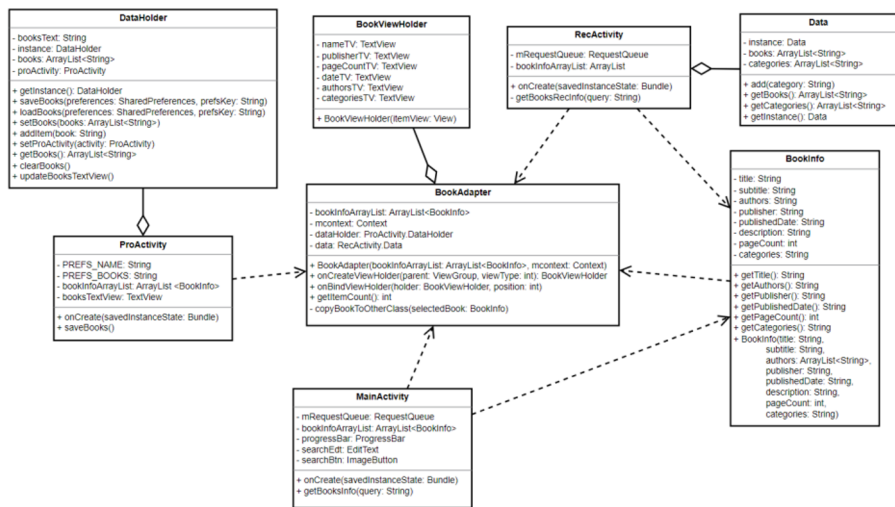


Fig. 5. Class diagram

The essence of the main "scenarios" of using the application is shown in the activity diagrams. The activity diagram of the procedure for obtaining the list of recommended books shows the scenario realized when at least one read book is added to the application (Fig. 6).

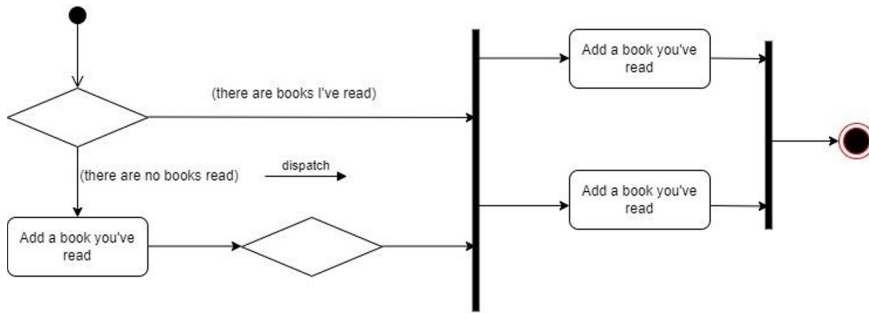


Fig. 6. Activity diagram

4 Conclusions

To develop the mobile application the following tools were used: Java Development Kit developer tools, Android Studio development environment, Android Emulator built into the development environment.

The application was developed in stages. At the first stage the project was created in Android Studio. Next, the main screen of the mobile application was developed, in which the ability to search for books and go to the screens of read and recommended books was realized. In the next step, the interfaces of the screens of read and recommended books were created. At the final stages, the library database is connected to the application, the algorithm of content filtering and the output of recommendations on the screen of recommended books are realized.

Manual functional testing of the application showed its performance and absence of errors in the process of work. The mobile application has been implemented in the municipal library and can be used by any reader to independently obtain a list of recommended literature.

The introduction of new technologies that simplify the work with readers allows not only to improve the quality of service, but also to attract more potential users to the library. In this regard, the use of mobile application in library activities will provide a sufficient economic effect.

Thus, the created mobile application carries a functionality that allows to simplify the choice of books, as well as significantly reduces the time to search for literature. The program does not require material costs for its installation, which is an undoubted advantage, and the functionality and system requirements allow you to use it on all mobile devices with the Android operating system.

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