

Structure Of Functional Processes And Information Model Of E-Referral Module Of The System For Medical Personnel Retraining

Elov Jamshid Bekmurodovich, Khamdamov Utkir Rakhmatillayevich, Sultanov Djamshid Bakhodirovich, Makhmanov Orif Qudratovich

Abstract: Today, the widespread use of information systems in all areas has led to significant growth in those areas. The use of such systems, especially in education, can improve the quality of education and reduce costs and save time. In this regard, the implementation of such information systems in the medical education process can improve the quality of the medical education system. This research is devoted to study and develop the processes involved in the e-referral system for the training of medical personnel. It drives the increase of the performance of this structure-based system.

Index Terms: medical information system, electron referral, data structure, processes, trainees, cycle, PNFL, distance education.

1 INTRODUCTION

Nowadays, the focus is on the creation of databases, corporate information systems and national content based on the development and implementation principles of management information systems. It is mentioned in the Strategy of actions for the further development of the Republic of Uzbekistan in 2017-2021 that "... development of effective mechanisms for implementation and use of advanced information and communication technologies, scientific and innovative achievements in practice"[1]. Based on these strategies, a "Concept of Healthcare System Development in the Republic of Uzbekistan for 2019-2025" was developed to further improve the system of medical education, science, and to integrate it into practical health care [2]. This concept envisages providing population with access to information about medical organizations and medical services as well as remote queues by creating a database system for the implementation of the "Electronic Health Care" system. According the abovementioned regulatory and legal aspects, the e-referral system for retraining of medical personnel was developed and implemented. This article presents the data structure of the remote online e-referral process for the retraining of personnel of medical organizations. A data structure (record set) is a way of storing data that ensures its efficient use. Often, a properly selected data structure allows you to create a more efficient algorithm. Choosing a data structure usually starts with choosing an abstract data structure. The data structure can be linear (each record has its own serial number) and non-linear.

Typical operations with data structures according to the [3] are as following:

- Create an empty structure
- Destruction of the existing structure
- Add Record
- Search for a record in the structure (by location in the structure or by key)
- Copying a Record Found Localizing a Record Found
- Delete found record from structure
- Moving a record to another position
- Finding a previous or previous record by the found
- Finding a record with a larger or smaller key Sorting a data structure
- Data structure measurement
- Combining (gluing) two data structures

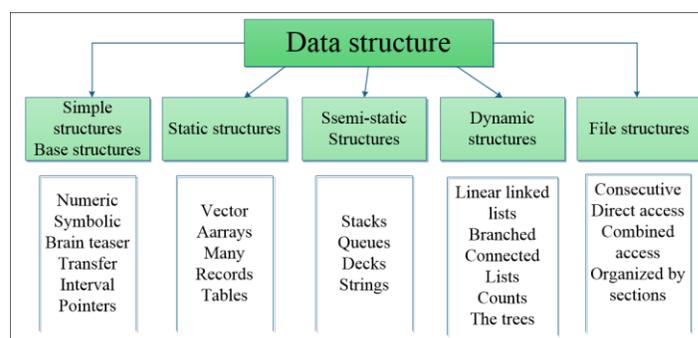


Fig1. Data structure

- Elov Jamshid Bekmurodovich¹, Khamdamov Utkir Rakhmatillayevich²,
- Sultanov Djamshid Bakhodirovich², Makhmanov Orif Qudratovich³
- Senior Lecturer, Department of Hardware and software of management systems in telecommunications, Tashkent University of Information Technologies, Tashkent, Uzbekistan
- Associate professor, Department of Hardware and software of management systems in telecommunications, Tashkent University of Information Technologies, Tashkent, Uzbekistan
- Associate professor, Department of Multimedia technologies, Tashkent University of Information Technologies, Tashkent, Uzbekistan

The above figure depicts the components of the data structure and their values. DATA STRUCTURE generally understand many data elements and many relationships between them. Such a definition covers all possible approaches to data structuring, but in each specific task its various aspects are used. Therefore, an additional classification of data structures is introduced, the directions of which correspond to various aspects of their consideration. Before starting to study specific data structures, we give their general classification according to several criteria [4].

2. RELETED WORK

Current research has been done by reviewing existing work in

data structures and their relations and also research on medical information system design and development. The work of O.S. Beznov entitled "Development of a methodological apparatus for creating a medical information system of a medical institution" has been analyzed [5]. A research of E.V.Vaganov entitled as "Medical information systems as an object of assessment: factors and development trends" has been studied and analyzed [6]. A PhD thesis with the title of "Modeling and evaluating the effectiveness of the functioning of the medical information system" of A.B.Gusev has been carefully reviewed [7]. A research work of A.S.Platonova entitled "Improving the quality of the functioning of the information system of multi-parameter control of educational activities" has been analyzed [8]. Models for development of medical information systems has been considered in all abovementioned research work. Using information systems serves for improving the quality of education and training process and expands the range of the possible borders of education even to the remote areas [10, 11].

3 MAIN PART

The concept of a control object, which displays an information model, is closely related to the concept of an information model. An information model is a formalized, interconnected set of identifiable and information-specific parameters that reflects not only the basic properties of modeling objects, but also the most significant relationships between them and the environment. The basis of information resources is information models. From the standpoint of quality content and semantics of information models, they are divided into three categories:

1. descriptive (descriptive),
2. resource (accumulation of experience)
3. intellectual (active).

Thus, "information" in the general case is an arbitrary description. The information model is devoid of such arbitrariness. It must meet additional requirements for its formalization and contain syntax, semantics, and pragmatics. The information model has a number of features. The first feature of information models is that one of its main functions is descriptive. This means that the model can be used as a means of describing an object, process or phenomenon. The second feature of information models is the multidimensional nature of the description, or multi-significance. Depending on the choice of the aspect of consideration, several information models can be formed on the same object. The third feature of the information model is that it can be a complex information unit. This can be a unit of processing in information systems, a unit of exchange in information technology, a unit of analysis in modeling systems. The fourth feature of the information model is that it always consists of simple information units [9].

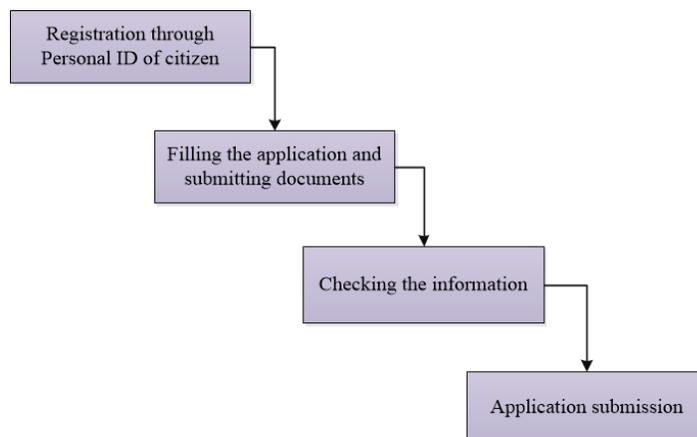


Fig2. Process of applying for electronic referral

In the first part, trainees can submit their applications from the distance. The institute for advanced training will review the application within the prescribed timeframe and also review the attached documents in electronic form, then accept and attach the application to the cycle that relevant to trainee's cycle. If documents are not matching, then they can be refused.

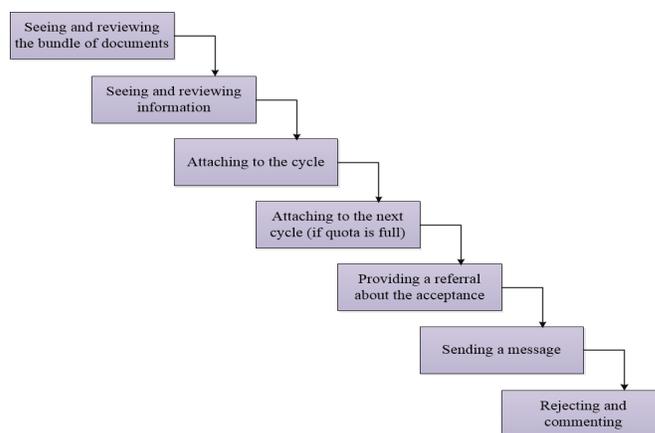


Fig3. Process for trainee registration

In this stage, the trainee is required to complete the following in the application process: First of all, it is required to register with the personal identification number of an individual (given in passport). After registration trainee has to provide the personal information and attach the necessary documents. After checks all the details once and submits an electronic application. In the next part of entire process an academic department of the institute for advanced training will review all applications submitted by the trainees. After checking all submitted information, academic department sends to the trainee a referral about the correctly accepted information.

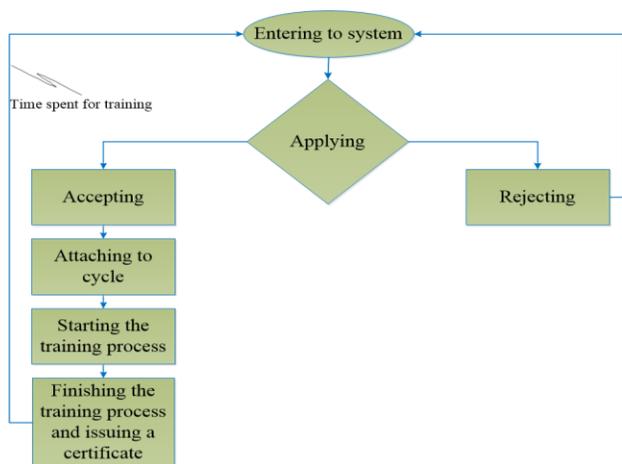


Fig4. The process for the review of applications by the academic department

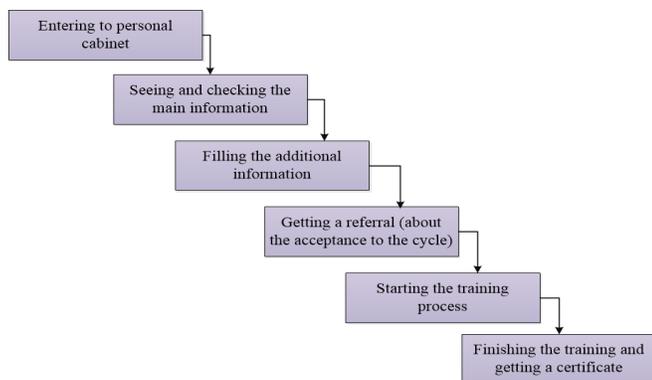


Fig5. Obtaining a referral and starting training program

In this stage trainee has to enter to his/her personal account in the system and checks own personal information. Then accepts the referral sent by the academic department and starts participating in training processes in set time period. By successfully finishing the training he/she can get a certificate. It is necessary to create a database for developing the system after committing the connections among the sub-processes. Accordingly, tables of the database and connections among these tables are formed. For that it is needed to create table called as following:

- Electronic_submission
- Student files
- cycles
- submission_notificacions
- cycles_type
- sub_notificacions_type
- submission
- departments
- study_years
- cycle_category
- faculties

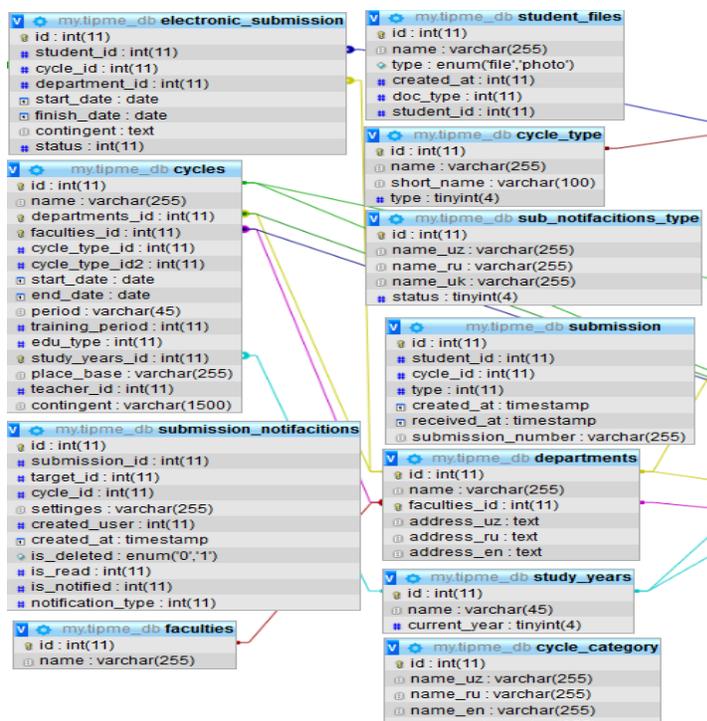


Fig6. Tables of the database of the system and connections between them

The main part of the information system for improving the qualification of medical personnel, especially in the module of issuing e-referral is a retraining subsystem. The information system includes 64 relationships that are formed as {R1, ..., R64}. In the relational data model all information is represented for user as table (relation) form and all actions in the database is organized in tables. Following relational calculation oriented algorithms have been developed for expressing the processes of the e-referral issuing module of the information system for medical personnel retraining:

- creating information for applying for the e-referral in its appropriate time (for ex. names of the cycle in budget cycle, their department and contingent);
- creating information of the process of reviewing obtained applications by the academic department that each application has been submitted to get referral (for ex. reviewing a bundle of documents, attaching to the cycle, issuing a referral to the applicant whose document is accepted, messaging).

It became possible to perform rational calculations through the creation of new relationships on the base of following equations (1)-(8) to commit above-mentioned processes.

faculty – R_1 relationship serves for designating the faculty names of the institution:

$$R_1[x_1, x_2] = \{r_1[x_1], r_1[x_2] | r_1 \in R_1\}, \quad (1)$$

where, $r_1[x_1]$ is a code of the faculty, $r_1[x_2]$ is a name of the faculty.

department – R_2 relationship serves for registering the departments belonging to the faculties of the institution:

$$R_2[x_1, \dots, x_6] = \{r_2[x_1], \dots, r_2[x_6] | r_2 \in R_2\}, \quad (2)$$

where, $r_2[x_1]$ is a code of the department, $r_2[x_2]$ is a name of the department, $r_2[x_3]$ is a code of the faculty and its value is obtained from $r_1[x_1]$, other additional information is denoted with $r_2[x_4], \dots, r_2[x_6]$.

study_year – R_3 relationship includes academic years:

$$R_3[x_1, x_2] = \{r_3[x_1], r_3[x_2] | r_3 \in R_3\}, \quad (3)$$

where, $r_3[x_1]$ is the code of academic year, $r_3[x_2]$ is the name of academic year.

cycle_category – R_4 relationship serves for designating the information of the cycle type (budget based or contract based):

$$R_4[x_1, x_2] = \{r_4[x_1], r_4[x_2] | r_4 \in R_4\}, \quad (4)$$

where, $r_4[x_1]$ is a code of cycle type, $r_4[x_2]$ is a name of the cycle.

cycle_type – R_5 is devoted to represent the categories of the cycle (such as professional retraining, general retraining, retraining within a specific topic, specialization):

$$R_5[x_1, \dots, x_3] = \{r_5[x_1], \dots, r_5[x_3] | r_5 \in R_5\}, \quad (5)$$

where, $r_5[x_1]$ is a code of cycle category, $r_5[x_2]$ is a name of cycle category, $r_5[x_3]$ is a shortened name of the cycle category.

cycle – R_6 relationship includes the information of the cycle which trainees have to be registered:

$$R_6[x_1, \dots, x_{15}] = \{r_6[x_1], \dots, r_6[x_{15}] | r_6 \in R_6\}, \quad (6)$$

where, $r_6[x_1]$ is a cycle code, $r_6[x_2]$ is a cycle code, $r_6[x_3]$ is a cycle type and its value is obtained from $r_4[x_1]$, $r_6[x_4]$ is a code of cycle category and its value is provided by $r_5[x_1]$, $r_6[x_5]$ is a code of faculty and its value is obtained from $r_1[x_1]$, $r_6[x_6]$ is a code of the department and its value is provided by $r_2[x_1]$, $r_3[x_7], \dots, r_3[x_{15}]$ are other additional information.

submission – R_7 relationship includes the information of the trainee e-referrals:

$$R_7[x_1, \dots, x_7] = \{r_7[x_1], \dots, r_7[x_7] | r_7 \in R_7\}, \quad (7)$$

where, $r_7[x_1]$ is a code of e-referral, $r_7[x_2]$ is a code of the trainee who obtained an e-referral, $r_7[x_3]$ is a code of the cycle which has been applied for e-referral, and its value is obtained from $r_6[x_1]$, $r_7[x_4]$ is a value of the status of e-referral (new, is being reviewed, accepted, rejected, delayed to the next cycle, accepted to the cycle), $r_7[x_5], \dots, r_7[x_7]$ are additional information.

submission_notificatio – R_8 represents conducting

correspondence between the academic department and the trainee who applied an e-referral:

$$R_8[x_1, \dots, x_{11}] = \{r_8[x_1], \dots, r_8[x_{11}] | r_8 \in R_{11}\}, \quad (8)$$

where, $r_8[x_1]$ is a code of correspondence, $r_8[x_2]$ is a code of e-referral and its value is obtained from $r_7[x_1]$, $r_8[x_3]$ is a code of cycle which an e-referral has been issued, and its value is provided by $r_6[x_1]$, $r_8[x_4]$ is value of the status of the e-referral (new, is being reviewed, accepted, rejected, delayed to the next cycle, accepted to the cycle), $r_8[x_5], \dots, r_8[x_{11}]$ are additional information.

4 CONCLUSION

This paper is devoted to develop the structures of functional processes, their data models and relational connections of the database of re-referral issuing module of the information system for retraining of medical personnel. The e-referral system based on this data structure and model serves for the improvement of the transparency of the educational processes and quality of the management processes.

REFERENCES

- [1]. Decree of the President of the Republic of Uzbekistan "On the Strategy for the Further Development of the Republic of Uzbekistan", Tashkent, February 7, 2017, No. UP-4947
- [2]. Decree of the President of the Republic of Uzbekistan "On comprehensive measures to radically improve the healthcare system of the Republic of Uzbekistan", Tashkent, December 7, 2018, No. PP-5590
- [3]. Aleksei Tepljakov, Algorithm and structure, 2008
- [4]. V.D. Daleka, A.S. Derevyanko, O.G. Kravets, L.E. Timanovskaya, Models and data structures, Kharkov 2000.
- [5]. 2. O.S.Beznos "Razrabotka metodicheskogo apparata dlya sozdaniya meditsinskoy informatsionnoy sistemi lechebnogo uchrejdeniya" Avtoref. Diss. Kand. Tex. nauk, Krasnodar 2008 g
- [6]. Ye.V.Vaganova "Meditsinskie informatsionnie sistemi kak ob'ekt otsenki: faktori i tendensii razvitiya" Vestnik Tomskogo gosudarstvennogo universiteta. Ekonomika. 2017. № 37. 114 str.
- [7]. A.V. Gusev "Modelirovanie i otsenka effektivnosti funkcionirovaniya meditsinskoy informatsionnoy sistemi" K.t.n., zamestitel direktora po razvitiyu Kompaniya «kompleksnie meditsinskie informatsionnie sistemi», jurnal vrach i informatsionnie sistemi, 2009 g, 4-14
- [8]. A.S.Platonova "Povishenie kachestva funkcionirovaniya informatsionnoy sistemi mnogoparametricheskogo kontrolya obrazovatelnoy deyatelnosti" Avtoref. Diss. Kand. Tex. nauk, Tambov 2012 g
- [9]. Resource Information Models, T. A. Ozherelyev, International Electronic Scientific Journal, Prospects for Science and Education. 2015.1 (13)
- [10]. Sultanov D, Kim K, Altmann J. Snooping Around a Fence: A Lesson from the Education Sector in a Software Service Ecosystem. In International Conference on the Economics of Grids, Clouds,

Systems, and Services 2018 Sep 18 (pp. 66-76). Springer, Cham.

- [11]. Sultanov, Djamshid. Strategies for Improving Education Services through Collective Value Creation. Diss. 서울대학교 대학원, 2019

AUTHORS' BIOGRAPHY



Elov Jamshid Bekmurodovich – PhD student of the Department of Hardware and Software of control systems in Telecommunication in the Tashkent University of Information Technologies named after Muhammad al-Khwarizmi. 100200, Tashkent, 108, Amir Temur str.



Utkir Rakhmatillayevich Khamdamov - PhD in Technical Sciences, Associate Professor, Department of Hardware and Software of control systems in Telecommunication of the Tashkent University of Information Technologies named after Muhammad al-Khwarizmi. 100200, Tashkent, 108, Amir Temur str.



Sultanov Djamshid Bakhodirovich - PhD in Engineering, Associate Professor at the Department of Hardware and Software of control systems in Telecommunication in the Tashkent University of Information Technologies named after Muhammad al-Khwarizmi. 100200, Tashkent, 108, Amir Temur str.



Makhmanov Orif Qudratovich - PhD in Technical Sciences, Associate Professor, Department of Multimedia technologies of the Tashkent University of Information Technologies named after Muhammad al-Khwarizmi. 100200, Tashkent, 108, Amir Temur str.