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Designing an Intelligent System of Social Danger Risk Assessment for Forensic Psychiatry

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Abstract

The present article is dedicated to design of intelligent system, which will help to make a risk assessment of socially dangerous acts committed by mental patients. In this article the author proves necessity of such system and describes steps of designing of its structure. Authors educed characteristics which influence on decision about need of regular medical checkup and choosing a type of coercive treatment. These characteristics presented as fuzzy variables and divided into three groups: "Socio-demographic characteristics", "History of Life", "History of the disease". During on the stages of the software process authors used graphical description language UML. Use case diagram, data base diagram and static structure diagram are presented. System interface is fully developed.

Keywords: social danger, forensic psychiatry

1. Introduction

The idea of applying computer technologies in the medical field is not a novel one. Active implementation of various diagnostic methods that utilize computer software began in the 1960s. Diagnostic software has proven particularly useful in the surgical field. This fact is determined by a number of considerations, such as the existence of objective symptom detection methods in this sphere. Psychiatry, on the other hand, scarcely makes use of computer diagnostics due to the difficulties in diagnoses classification and symptom detection (Amar, 2002).

Prevention of psychiatric disorders and their negative consequences is an important concern for psychiatry in the Russian Federation. One of the grave social issues is the perpetration of socially dangerous acts and crimes by people suffering from psychiatric disorders. Refining the measures for preventing socially dangerous acts committed by the mentally ill thus becomes one of the promising and strategically important vectors of the general and forensic psychiatry's development.

In the current context the work of psychiatrists, including that of forensic psychiatrists, deals with analyzing a tremendous amount of patient-related information. As a result even the most experienced specialists have difficulties taking into account all of the relevant information in each patient's case, which in turn affects the precision and efficiency of psychiatric hospitals' performance. One of the conceivable ways of resolving this problem is the integration of innovative screening methods into the forensic psychiatrists' practice.

2. Method

2.1 The structure of the intelligent system

In the course of our analysis of the existing scientific works related to information technologies in psychiatry, we have detected three processes where utilization of the intelligent system is viable:

- Deciding whether active outpatient monitoring is necessary;
- Deciding on the type of compulsory treatment;
- Public danger risk assessment.

The key issue in our approach to the solution of these problems is the social danger risk assessment. From the

forensic psychiatry point-of-view a socially dangerous act committed by a mentally ill person is an action or inaction that, on one hand, is specified by the criminal code, and on another – is perpetrated involuntarily, neither with intent or through negligence, but due to a lack of capability to adequately perceive the environment and to consciously control one's behavior (Briken, 2009).

The essential methods for assessing the risk of mentally ill people's dangerous behavior are clinical and statistical predictions. The latter is based on establishing the risk factors that are determined in empirical research and evaluated with a formal approach in each case. In the discussion of the clinical prognosis of danger to society forensic psychiatrists justifiably stress the importance of the "syndrome – personality – situation" triad analysis and the determination of the mechanism of the committed wrongful act.

First of all, it is necessary to design the patients' personal information database in a way that makes it easily operable both manually and automatically. It's necessary to provide a reliable authorization and information encryption system in order to eliminate the possibility of confidential personal data being used for illegal purposes. At the same time the process of database population has to be as simple and user-friendly as possible. Access to various levels of information has to be organized according to RBAC (Role Base Access Control) selective access policy.

Each group of users should possess certain rights and responsibilities. For example, members of the administrative group are responsible for the system's stable functioning, system and network setup, new member registration and do not deal with the medical aspects of the software functioning.

2.2 Case Diagram

The case diagram reflects the relationships between actors and cases. For this purpose the members of the following groups are considered actors:

- administrators;
- doctors;
- assistants.

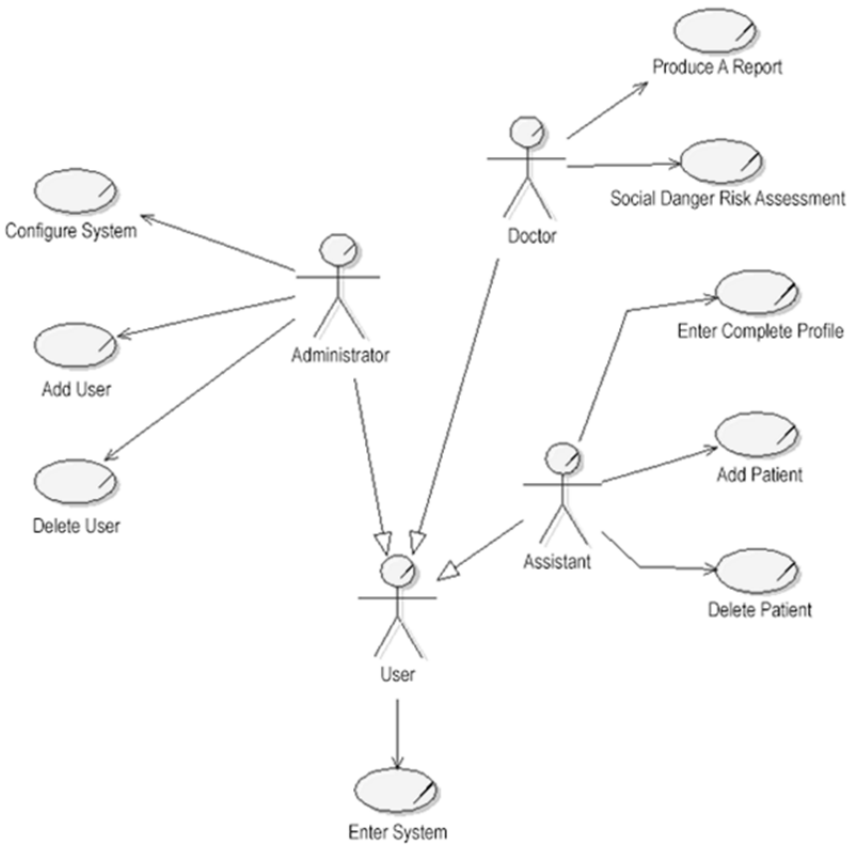

Figure 1. Case diagram

Such selective access will allow for the fullest degree of flexibility and efficiency in the expert system usage.

The “doctor” group users have the most extensive rights in patient data management. It is the only group of users that may refer to the social danger risk assessment analytical complex, as well edit the patient's personal data and the list itself.

Paramedical personnel is included in the “assistants” group. This group deals with database population – entering the patients' information, including the official records data, social and demographic characteristics, medical history and psychiatric state at the time of data entry. This group's access rights practically duplicate those of the “doctor” group, with the exception of the possibility for patients' personal information analysis.

Diagram of the expert system precedents is presented in figure #1.

As the diagram informs us, the “administrator” group is responsible for system configuration, user registration, user data editing, including user deletion, and completion of medical paperwork. The system configuration is presented in a separate form. Among all the items present we should emphasize the database parameter configuration: the server IP address should be entered in a separate form along with the login and password for database access. When working with a non-MySQL database, additional function libraries must be uplinked. Database configuration and connection must be conducted every time a new client is initialized. The settings are saved in a separate file on a personal computer.

The doctor's key function as he/she is working with the expert system is to analyze the patient's personal data and draw a conclusion on the basis of the information involved.

The social danger risk assessment complex addresses the patient information related to one of the four above-mentioned categories (social and demographic characteristics, medical history, present illness history and present psychiatric state). An elaborately detailed description of each patient is needed to achieve the system's maximum efficiency level.

The doctor can base his decision on the necessity of active outpatient monitoring on the system's results – the social danger risk assessment score, which allows to deliver a substantiated opinion on whether to include or exclude the patient from the active outpatient monitoring group.

The social danger risk assessment by the expert system is possible in order to make a decision on the type of compulsory treatment. There are four types of compulsory treatment:

- Mandatory outpatient monitoring and psychiatric treatment;
- Inpatient treatment in a general psychiatric hospital;
- Inpatient treatment in a specialized psychiatric hospital;
- Inpatient treatment in a specialized psychiatric hospital with intensive monitoring.

Detailed statistics on each patient that allow for comparisons between patients are built up. This information may be used by a medical board as well as by the software developers in order to modify the system.

It must be noted that even if unequivocal results are attained through the expert system, the final decision is still made by the medical board, and the expert system conclusion should in no case be accepted by the medical board without additional analysis of the patient's state, even though it can certainly contribute to making a sound decision.

Unlike the two aforementioned groups, the existence of the “assistants” group members is not an essential prerequisite for the system's functioning. However, an “assistants” group member can significantly unburden members of the two other groups of the monotonous tasks.

All personal information should be grouped in the following manner (Gazha , Baranov, Eroshina & Tulupova, 2009):

1. Social and demographic characteristics:

- Passport information;
- Social and professional environment data;
- Material welfare;

2. Life history:

- Family information;
- Upbringing environment;

- Upbringing conditions;
- Education;
- Professional activities;
- Hobbies;
- Predisposition to addiction;
- Criminal record;

3. Medical history:

- Hereditary background;
- Diagnosis as per ICD-10;
- Nature of disorder;
- Treatment history;
- Current psychiatric state as revealed by the syndromes observed at the time of information input.

2.3 Deployment Diagram

The deployment diagrams serve to model the network configuration for all of the processing nodes (Gromov, Ivanova, Belyaev & Danilkin, 2013).

Deployment diagrams are usually utilized in designing static systems from the deployment point of view. It should be noted that creation of deployment diagrams is required only for those systems that are meant to function on several processing nodes.

Since our system is based on client-server architecture and should include at least three processing nodes (doctor's PC, administrator's PC, database server), it has to be described with a deployment diagram (Gromov, Zarandia, Zemskov & Borisov, 2004).

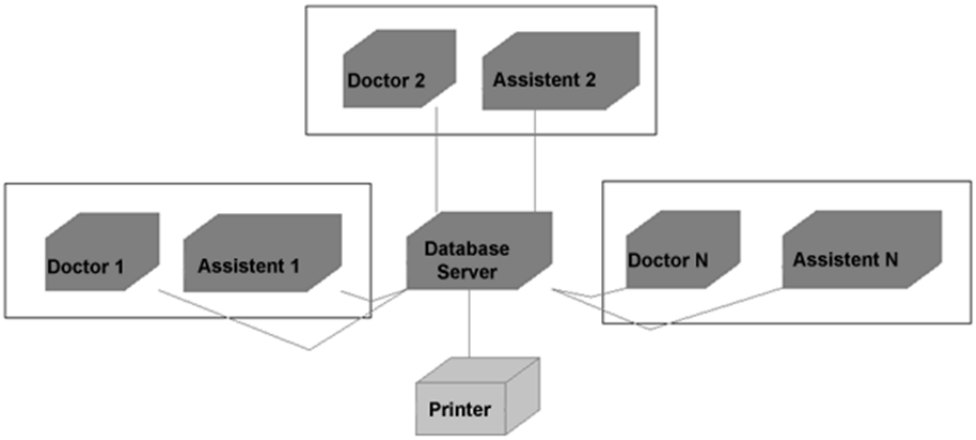

Figure 2. Deployment diagram

The deployment diagram configuration may differ depending on the number of personnel and number of processing nodes (PCs). Figure #2 offers a viable deployment scheme for the expert system. This scheme is feasible for describing the network configuration of a system with an unlimited number of “doctor-assistant” pairs, one administrator and a printer with a condition of a separate PC for each user. At the same time, any user may use any available PC and access his/her patients' information owing to the RBAC (Role Base Access Control) selective access policy.

2.4 Database Diagram

Figure #3 presents a database diagram of the system under development (Gromov, Polyakov, Verdnikova, Minin, Samharadze, Ivanova, 2012). A similar database structure was developed for storing both users and patients' personal information on one server. The database consists of six tables.

1. “users” – contains information about system users;

2. “permissions” – links patients to their doctors (required for RBAC selective access);

3. “persons” – contains general patient information, including passport records and ICD-10 diagnosis;

4. “features” - a list of the following characteristics: social and demographic characteristics, life history, medical history, current psychiatric state;

5. “options” – contains options for the “features” section;

6. “characteristics” – contains all characteristics for all patients.

The “users” table contains general information about the patients and consists of the following fields:

- id – user identifier;
- login – user program login;
- pass – user's hash password;
- name – user's real first and last names;
- group – number of one of the user groups (doctors, assistants, administrators);

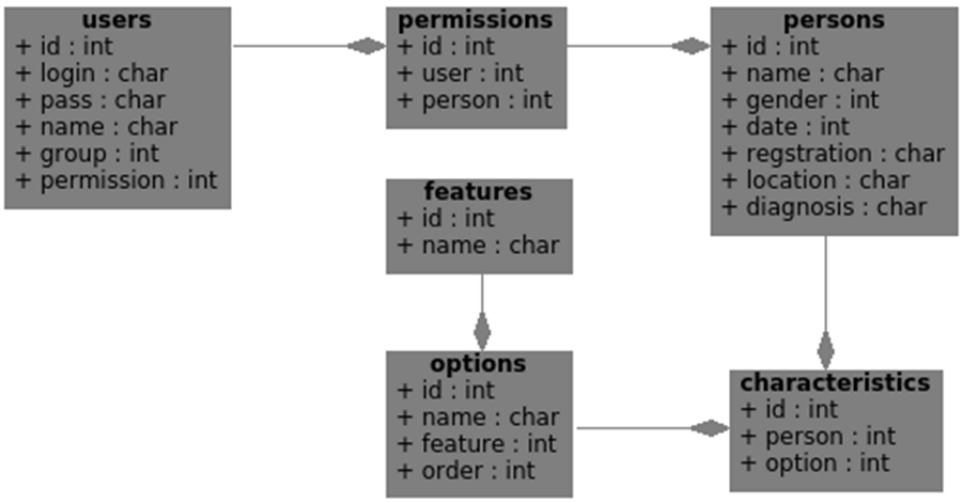

Figure 3. DB Diagram

The “persons” table contains general information about the patients and consists of the following fields:

- id – patient identifier;
- name – patient's first, middle and last names;
- gender – patient's gender;
- date – patient's date of birth;
- registration – patient's permanent address;
- location – patient's current address;
- diagnosis – ICD-10 diagnosis.

The «permissions» table is an auxiliary one and links the patients to their doctors. The table contains the following fields:

- id – parity identifier;
- user – user identifier;
- person – patient identifier.

The «characteristics» table contains information on the patient's characteristics. The table contains the following fields:

- id – parity identifier;
- person – patient identifier;
- option – identifier of the selection made for the characteristic.

The database “features” and “options” tables have been created in advance and as the system is deployed they are installed on the database server from an sql-file. If necessary the developers can revise the tables and send the updated sql-file to the administrators of the already deployed systems.

The “features” table contains all possible patient characteristics and consists of two fields:

- id – characteristic position identifier;
- name – name of characteristic, appears in the program dialog box of the patient personal data entry.
- The “options” table contains all of the patient characteristic options and consists of four fields:
- id – characteristic option identifier;
- name – text or numerical option for the characteristic position;
- features – option characteristic identifier;
- order – sequential number of the option, to make the “select” field and other similar fields in the dialogue box convenient for entering the patients' personal data.

All characteristics are subdivided into three groups: social and demographic characteristics, life history, medical history. According to the doctors' personal experience and the methods in place of solving the following problems - deciding whether active outpatient monitoring is necessary, deciding on the type of compulsory treatment, public danger risk assessment – the following form was introduced for patient data storage. The characteristics themselves are stored in the “features” table, and the options for these characteristics are stored in the “options” table (Eroshina, Baranov & Abashina, 2009).

1. Social and demographic characteristics:

- Education level: none, primary school, middle or incomplete secondary school, secondary school, professional secondary education, incomplete higher education; higher education, no data;
- Marital status: unmarried, married, in a domestic partnership, divorced, widowed;
- Social and professional environment: self-employed, physical labor qualified physical labor, intellectual labor, does not work;
- Disability: not disabled, disability category 2, disability category 2, disability category 1, no data;
- Legal capacity: competent, incompetent, no data;
- Incompetency determination initiated by: relatives, organization;
- Legal guardian: none; relatives; organization;
- Living conditions: own apartment, private house, communal apartment, dormitory, rental housing, no fixed address, home for the disabled (psychiatric hospital), no data;
- Resides with: alone, with parents, with spouse, with children, with other relatives, with friends, no data;
- Subjective view of living conditions: unsatisfactory, satisfactory, good, very good;
- Material well-being: financial distress, resources for food only, resources for food and inexpensive recreation, no financial difficulties, high level of material well-being.

2. Life history:

- Mother's pathology of labor: none, premature labor, cesarian section, prolonged labor, asphyxia, birth defects, no data;
- Brought up by: a two-parent family, mother only, father only, relatives, foster family, in a residential facility, no data;
- Characteristics of family upbringing: chronic conflicts, insults and beatings, neutral relationship, attachment, no data;
- Relationship with parents in childhood: periodic conflicts, insults and beatings, neutral relationship, attachment, no data;
- Parents' relationship: conflicting, indifferent, warm, no data;
- Developmental problems: none, delay, no data;
- Academic performance: good and excellent, satisfactory, unsatisfactory due to emotional-behavioral reasons, unsatisfactory due to cognitive reasons, unsatisfactory due to somatic-neurological reasons, unsatisfactory for

social reasons, no data;

- Attitude towards school: willing to learn, unwilling to learn, no interest towards school, no data;
- Hobbies in childhood: varied and stable, varied and unsteady, scanty and unsteady, no particular hobbies, no data;
- Hobbies: none, music and art, technical and model-building, collecting, sports and tourism, other hobbies, no data;
- Pastimes: reading and watching TV, clubs, on the street in company of peers, with family, no data;
- Delinquent behavior in childhood: none, running away from home, disorderly behavior, drug and alcohol usage, misconduct in school, other;
- Youth liaison service: on record, no record, no data;
- Reasons for being registered with the youth liaison service: petty theft, disorderly conduct, running away from home, misconduct, drug or alcohol usage, other, no data;
- Premorbid personal qualities: schizoid, epileptic, exclusive, unstable, disthymic or syntonic, hysterical, asthenic, psychasthenic, mosaic;
- Post-secondary education: none, training course, trade school, vocational school, college, no data;
- Army service: no peculiarities, released from active duty for medical reasons, released from active duty due to a psychiatric condition, didn't serve for medical reasons, didn't serve due to a psychiatric condition, didn't serve due to criminal record, didn't serve for other reasons, no data;
- Alcohol abuse: didn't drink, episodic use, systematic use, dependency;
- Drug abuse: didn't use, episodic use, systematic use, dependency;
- Social microclimate: limited to family and closest relatives, a stable circle of friends and acquaintances with a positive social attitude, antisocial and criminal tendencies in the environment, limited to casual acquaintances and based on alcohol abuse, lack of stable social connections;
- Characteristics of the relationship with the immediate circle: extremely uncooperative; frequent periodic domestic conflicts, neutral relationship, positive relationship;
- Conviction record prior to the disease onset: no, yes;
- Age of criminal conviction;
- Total number of conviction records;
- Type of offense: violent crime, crime against property, sexual, antisocial, no data;
- State when committing the offense: under the influence of alcohol, under the influence of drugs, sober, no data;
- Imprisonment: yes, no, no data;
- Socially dangerous acts in the past (in a mentally disturbed state): yes, no;
- Number of socially dangerous acts (in a mentally disturbed state);
- Characteristics of socially dangerous acts in the past (in a mentally disturbed state): violent crime, crime against property, sexual, antisocial, no data;
- Compulsory treatment in the past: none, outpatient, general hospital, specialized hospital, specialized hospital with intensive monitoring;
- Number of treatments conducted;
- Frequency of hospital regulations' violations: none observed, single, several, major regular;

3. Medical History

- Genetic history burden: no, yes, no data;
- Burdened genetic history: alcoholism, schizophrenia, oligophrenia, personality disorder, organic injury, epilepsy, other, unknown psychiatric problem, no data;
- Which relatives: father, mother, brothers or sisters, other relatives, no data;
- Year of the illness onset;

- Year of first psychiatric referral;
- Date of diagnosis;
- Type of monitoring: consultation group, outpatient monitoring, active outpatient monitoring;
- Frequency of outpatient visits in the monitored period: regular, periodic at times of aggravation, rare, once;
- Type of referrals: self-initiated, called in, actively monitored at home, referred by relatives;
- Treatment in a psychiatric hospital: never, treated on account of a psychiatric condition, treated on account of alcoholism;
- Hospitalization frequency per year: once a year, more than once a year, less than once a year;
- Reasons for hospitalization: symptom aggravation, behavioral disturbances, alcohol abuse, drug abuse, pre-arranged hospitalization for Disability Determination Services;

3. Results

The problem of effective social danger risk assessment exists due to, first and foremost, by a large number of syndromes and factors. This is exactly the reason why the task of developing a new intellectual system that utilizes the ICD-10 diagnosis classification, and thus can be used in Russian psychiatric hospitals, including those related to forensic psychiatry, is of vital importance. There are three processes that require automatization: deciding whether active outpatient monitoring is necessary, forensic psychiatric expert commission's decision on the type of compulsory treatment and public danger risk assessment. Besides the analytical block of the public danger risk assessment, which is used in the automatization of all three processes, the intellectual system also requires a data storage, which is uplinked through electronic document flow.

References

Amar K. D. (2002) *Computers in psychiatry: a review of past programs and an analysis of historical trends.* Psychiatric Quarterly, 3(4)

Briken, P., et al. (2009). Antiandrogenic pharmacotherapy of sexual offenders and home leave steps in the forensic psychiatric hospital Berlin. *Psychiatr Prax, 36*(5), pp.232-237)

Eroshina, O. S., Baranov, A. V., & Abashina, V. V. (2009) *Mechanism of social dangerous act committing as factor of relapse risk prediction.* Collected works of all-Russian school of young scientists in the sphere of psychiatric health. (pp. 58 – 63)

Gazha, A. K., Baranov, A. V., Eroshina, O. S., & Tulupova, O. V. (2009) *A public danger prognosis for the mentally ill patients in compulsory treatment at specialized psychiatric hospitals.* Medical and social priorities of preserving Russian population's psychiatric health. (pp.134-135)

Gromov, Y. Y., Ivanova, O. G., Belyaev, M. P., & Danilkin, S. V. (2013) *Methods and tools in modeling information systems. Object-oriented approach: teaching aid.* Tambov; M; Spb, Baku, Vienna, Hamburg; International center for technology and innovation “Nobelistica” publishing house.

Gromov, Y. Y., Minin, Y. V., Korshikov, S. N. Malik, D. O., & Nosov, S. V. (2011) *Datamodel building on basis of variation of intuitive fuzzy rations.* Data and safety. Puplishing and Printing center of Voronezh State University. Voronezh. (pp. 567-570).

Gromov, Y. Y., Polyakov, D. V., Verdnikova, A. P., Minin, Y. V., Samharadze, T. G., & Ivanova, O. G. (2012) *Construction of multidimensional membership functions.* Instruments and systems. Management, control diagnostics.

Gromov, Y. Y., Zarandia, Z. A., Zemskoy, N. A., & Borisov, A. N. (2004). *Utilizing logic-linguistic models for describing the subject field of professional activity. Shaping a professional under regional conditions.* New approaches: Materials of the V Russian inter-university scientific conference, Tambov. (pp.20-21)

Kotov, V. P. (2008) *Criteria and basis of differential use of compulsory measures of medical character to persons with serious psychological disorder, committed social dangerous acts. Methodological recommendations for physicians*. The Serbsky State Scientific Center for Social and Forensic Psychiatry. Moscow.

Malceva, M. M., & Kotov, V. P. (1995). *Dangerous actions of the mentally ill patients.* Moscow: Medicine.

Robert L. Spitzer, Jean Endicott. (1968). *A computer program for psychiatric diagnosis utilizing the differential diagnostic procedure.* Arch Gen Psychiatry.

Tkachenko, A. A. (2012). *Guidance for forensic psychiatry.* “Uright” publishing house.

Usov, G. M., & Ivanova, A. A. (2007). Analysis of risk factors of social dangerous acts committing for schizophrenes. *Russian psychiatry magazine, 5*, 15-20.