A View over Appling Informatics Systems in Forensic Expertise

OCTAVIA MORANCEA[1], HARITON COSTIN[1]
[1]The "Gr. T. Popa" University of Medicine and Pharmacy, Iaşi
Str. Universităţii 16, 700115, Iaşi, Romania

Abstract: - The paper presents a view regarding informatics applications resulted from the experience and research in forensic medical field. Based from the beginning on the fact that the forensic medicine is a pure medical specialty which communicates with the justice, the criminality laws and the criminology, the authors tried to demonstrate that the forensic specialist can be released by a series of procedures and interpretations that may become subjective, using a dedicated application. Following this principle, the application will have a good influence in the legal medicine expertise.

Key-Words: - informatics system, forensic medicine, communication, system integration

1 Introduction

The medical informatics is an interdisciplinary science which deals with studying the computers applications in practice and in medical research, and the study of acquiring, stocking, transmitting, protection, poaching and usage of medical information. [1]

The quick technical progress from medicine brings sometimes wrong concepts when the techniques and the investigation algorithms modes are misaddressed with the medical thought and synthesis. The danger can be avoided by integrating the medical activity. An informatics system in medicine appears like an integration necessity of numerous data and medical procedures.

The main advantages for medical informatics integration are:

- The medical expertise it's available equally, independent of the place the patients lives
- The patients receive more information and better services
- The quality of medical services is improved by assuring a bigger availability of patient information
- Health services can improve the efficiency and the productivity, reducing the administrative, less useful work, with restarting the electronic information and distribution of tasks between health care institutions and the care employees
- Information exchange must agree with the security and confidentially aspects for the patient
- The medical knowledge is more accessible
- The repetition of lab exams and medical analyses are avoided
- A permanent and continuous training must be assured for users-medical employees
- Can be organized an adequate usage of local and regional resources [2]

2 Problem Formulation

In this context, the forensic medicine is a pure medical specialty which cooperates active with the justice, the criminalistics, the criminology and why not with informatics?

The application's purposes are to carry out the forensic specialist of a series of interpretations which appertains to the subjective domain. Following this principle, we state that an application having a legal medical purpose will positively influent the experts in capitalizing the medical expertise and helps in finding the truth. [3]

The proposition of our application assumes the development of a platform orientated on services (SOA – Service Oriented Architecture), which can allow e-health knowledge and facility. The software is divided into services which can be component – base software (component – based software), offering the requested information. The medical personnel will have a permanent access to the dossier for every registered case, on the base of the social Web (meta-data, ontological descriptions, social networks etc). The data will be stocked in a distributed mode, using data bases services (DB). The architecture will be multi-platform, weak-connected type, offering the easy integration of the applications, services and systems, at the Internet level.

Developing the application, we have used the main functionalities:

- Computer assisted diagnosis decision in forensic expertise
- Recording the expertise in data bases
- Searching in data bases by several indexes: the cause of death, the date of death, age, sex etc
- Reports after: sex, age, cause of death
- Ballistic analyze:
  - o Establishing the type of the gun that was shoot

o Determination of shooting direction and the distance it was shoot

o The position of person that shoot

o Computation of other indices: death hour, cause of death, the trail described by a falling person, the height calculated by the bone length using formulas, theorems, equations and mathematical relations

• Several trailer comparisons: hands, feet, transportation tracks

• Computer wording of legal medical documents, with the possibility of printing the documents: legal-medical certifies, expertise reports, autopsy reports – for the police, other expertise reports – to judges, analyses requests for dozing the blood alcohol – to the inter ministry, draft-maps for bleeding, clinical examination bulletins, toxicology-alcoholism analyses bulletins [4]

• The possibility of recording sound, images and videos, stocked in data bases; the possibility of making draws

• Communication – the information can be sent to police, judges, laboratory, hospital or other interested institutions [5]

Figure 1. The main menu of informatics system for forensic expertise

The architecture of the application is shown below:

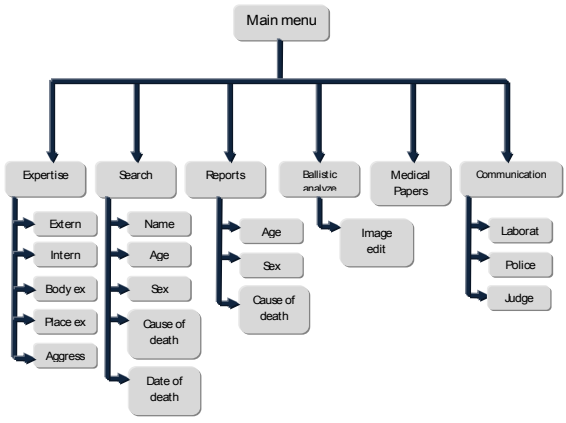

Figure 2. The application's architecture

3 Problem Solution

The project's purposes were to develop a complex informatics system, under a platform based on services, with internet connectivity, in order to hash intelligent information and to assist decisions in expertise for forensic medicine.

The complex character results from the many modules that were implemented: Electronic Health Record for patients and for the aggressor, forensic papers and certificates, decision support system, complementary investigations, a communication module, a laboratory module, an imagistic module, an administration module, a help module. Also, the system allows automatic generation of several reports and statistics.

After acquisitioning the data from the patient and after a local rehashing of information, the essential data are sent through Internet or GSM/3G to a server from the Legal Medicine Institute (LMI). The application's modules will be correlated on two levels: a local data hashing and a server data hashing. The software's general architecture will be of client-server type and the project proposes the development of a platform oriented on service (SOA – Service Oriented Architecture).

The main goals of the proposition is to realize an integrated informatics system which will assume the following hardware components: a Tablet PC or PDA (Personal Digital Assistant) – which will be held by the expert, personal computers (PC) for forensic cabinets and a central server with internet connectivity for databases.

The results obtained after the data's reshape can be concretize in several statistics needed for medical institutions, health financing systems, as for scientifically purposes. Also they can be sent to the central server or to interested institutions: Police, Court, Laboratory etc.

The system has several functionalities:

1. Medical-legal expertise – offers a view to the three steps which must be followed in a forensic expertise, conforming to the expertise procedures. The three steps are: the exam at the place where the body was found, the autopsy of the corpse, the complementary exams: histopathological, serological, and toxicological. The expertise function of the injuries is made of extern examination, intern examination and result synthesis.
2. Search – offers possibilities of querying the data base in order to easily find records. Can be made searches by name, age, sex, cause of death, date of death etc.
3. Reports – we can generate reports after diverse criteria under a table form or other forms which could represent suggestively the specific data assemble to each report. There are reports generated by sex, age, cause of death etc.

4. Ballistic analyze – its goals are to scientifically research the main and secondary trails, the bullet tube and the target in order to establish the firing direction and distance, the type of air stick and its identification. [6] The classification of fire guns can be made by several criteria: after destinations, after the after the functional mode, after the caliber, after the used munitions. The effects of shooting: the force and the kinetic energy of a bullet is equal with:

$$E = \frac{mV^2}{2}$$

Where m = the projectile mass;
V = residuary speed
The projectile mass is equal with the weight divided by gravitational acceleration force (9.81):

$$m = \frac{p}{q} = \frac{p}{9.81} = \frac{p}{10}$$

From where:

$$E = \frac{pVr^2}{20}$$

Also the application has an image editor which allows the loading of photos and their issuance, applying several effects, zooms and rotations. [7]

5. Parameters computations – several parameters can be calculated: the hour of the death, the death cause, the trail described by a fallen person, the height calculated after the length of bones with several formulas, theorems, mathematical relations and formulas, several trail comparison of hands trails, foot trails, transportation trails. These calculi have the purpose of releasing the forensic experts of something which could be very simple generated by the computer. [8]

6. Medical legal papers – the application is enriched with a collection of papers from which one can select what he wants. The documents can be sent to printer. Also it can be sent to laboratory, police and judge. [9]

7. Communication with other systems – the application allows the interconnection with other informatics systems: the informatics system from the laboratory of analyzes the informatics system from the police, the informatics system from law and the data exchange between them. From the point of view of dates which communicate between two systems, the following were set up:

- The security of data connection: the data transmitted must be secure in order to reduce as much as possible the way of interception and the compromising by a third person.
- The confidentiality of data referring to the nature of the data which are being transmitted between the two parts
- The integrity of the transmitted data: if big amount of data is transmitted it is necessarily to be received correctly
- Files sending: practically, all information sent between physicians must use the internet as a communication canal
- Individual verification of a patient. Through the actions made by the expert the verification of a patient can be done in order to verify the GP's office he appertains

Figure 3. Aspects from the application

Our application assumes creating and developing applicable software for elaboration assisted by computer of medical-legal documents (forensic certificates, forensic expertise, forensic reports for necropsy, criminalist exam, toxicological exam etc). So, all forensic papers will be standardized, discharging the subjective factor, influencing positively in this manner, the forensic activities, arising the scientifically character of the expertise.

Economically speaking, the project development will determine lower costs for data sending, both in Legal Medical institutes and departments and in other public institutions (Police, Court, Laboratory etc). Also a quick sending of secure and confidential medical data is desirable.

From the technological, knowledge and from medicine based on proofs view, the project assumes a hardware and software implementation of a complex system with all acquisition facilities, real time analyze and data transmission in legal medicine. The software implementations use advanced techniques of rehashing signals. Artificial intelligence for medical data analysis, will integrate specific medical knowledge, will use modern methods to encode the information and web technologies (semantics included) for the most functions of our system. For example, the prediction of the death date and hour will assume the research and the implementation of an expert system based on rules (fuzzy) or a hybrid – a project's innovative method. Similar, for all other modules of decision assistance, paradigms and Artificial Intelligence will be used,

combined with advanced methods of numerical computations.
Not least, the applications for forensic mobile expertise, realized by the expert heeled with the standard case for the forensic expertise and a portable computer/PDA (with GSM/UMTS and GPS) are another complex challenge of this project, with practical implications in raising the expertise precision.
The application will include the following hardware and software components, the last one being specific goals and S/T original problems:
A. A local sub-system, formed by a portable computer/PDA computer for primer acquisition and hashing of specifics data, with Internet connection, GSM/UMTS and GPS module incorporated
(1) For a mobile subject the data acquisitions and hashing will be assured by a PDA computer connected with RPT and will be sent through GSM/UMTS and GPS modules
B. A computer – server for data bases and other applications, located at the Regional Center of Legal Medicine (RCLM). Here, the on-line tele-diagnosis, the off-line tele-consultations and the tele-education for subjects and population will be allowed.
C. Application programs for:
(1) Acquisition, analyze and transfer of medical data to the central server for a stable or a mobile user;
(2) Programs for a bilateral communication between the local sub-system and the central server;
(3) Specific applications of forensic tele-expertise and tele-education;
(4) Supplementary data hashing on the central server (for medical statistics, searches);
D. Expert systems for the knowledge/data bases installed on server and/or personal computer or PDA:
(1) a program to assist decisions in order to compute the probably death date and hour;
(2) a system to assist decisions in order to establish the alcohol value at a moment;
(3) a system to assist decisions in order to establish the number of medical care days (in traumathological expertise and legal medical papers)
(4) a system to assist decisions in anatomy-pathology imagistic
E. A program for informatics management of the system, installed on server
Another specific goal is the application's implementation to all Legal Medicine Institutes, as to the forensic county services from Romania.
So, millions of possible direct and indirect users and also the health care systems financiers will be the main beneficiaries of the application.
The project proposition is an answer to some of the current society challenges, will escape the forensic expert of a series of interpretations that may become subjective, helps him with a decision assistance, reduces the time spent for manual computations, statistics, reports or papers filling in.

4 Conclusion

The medical software market is extending. The expectations are in developing new, performance, highly efficiency and safety software. We've tried to conceive and develop software which gives to the user all the solutions needed. The application offers to forensic specialists the possibility of relieving the time needed for manual calculations, statistics, and papers filling. More than that, the costs will lower because of the electronic support usage, this thing facilitating an easy information transfer (in electronic format) between the forensic and the institutions he is related with. Also the purpose of the application is to relieve the specialist from conventionalism activities and to permit a better concentration on diagnosis. The informatics systems offer to legal medical laboratories a powerful tool for the management of work. The time can be measured, the information flows more efficient in the analyze process, so the work-time is reduced, allowing the final reports to be submitted quicker. [10]
The final product is a pilot project for developing a complex informatics system, which integrates the operational functionality in the forensic domain. Its purpose is to enrich the specific medical services and to offer a powerful instrument for interested persons in order to optimize the data hashing and data management, filling emptiness in the informatics applications for the legal medicine and justice.
All these product qualities offers the assuredness that our application will gain a real success among physicians.

References:

[1] Bemmel, JH, „Handbook of Medical Informatics", Ed. Springer, 2000.
[2] Stoicu-Tivadar L.- „Sisteme informatice aplicate in servicii de sănătate", Ed. Politehnica, 2005
[3] Stoicu-Tivadar L., Morancea O., Purdel A., Srbin L., Djan M. – „Communication Suport in Healthcare – a didactical approach", Proceedings of Euro-Mediterranean Medical Informatics and Telemedicine International Conference, May 2007, Mangalia, Romania, ISBN 978-973-739-423-1, pp. 37-43
[4] Morancea O., Purdel A., Srbin L., Djan M. – „A Technical Students View Regarding The Development Of Health Informatics Projects And Multidisciplinary Cooperation" – Proceedings of the

European Federation for Medical Informatics, Special Topic Conference, June 2007, Brijuni, Croatia, ISBN 978-1-58603-763-5, pp 68-70.

[5] Quai I., Terbancea M., Mărgineanu V. – „Introducere în teoria şi practica medicală", Ed. Dacia, 1978

[6] Golunski A.– „Criminalistică", Ed. Ştiinţifică, 1961

[7] Panaitescu V., Trâmbiţaşu A. – „Caiet de lucrări practice de medicină legală", Ed. Sylvi, 2001

[8] Dan N. - „Dicţionar de criminalistică"

[9] Jef Raskin, „The Humane Interface - New Directions for Designing Interactive Systems", Ed. Addison-Wesley, 2000.