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Smart Hospital: Automation of Business Processes in medical centers

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***Abstract*— "Automation business processes in hospitals" is the subject of this article. Healthcare organizations now strive to deliver patient treatments that are reliable, cost-effective, and of high quality. To do so, the first step is to simplify existing procedures. Healthcare is expected to be one of the main growth fields for automation process systems in hospitals. We look at how the system could be used to build a smart hospital in this study.**

Indeed, the framework was used in conjunction with a variety of technology and methodologies, resulting in a project with a high level of productivity and versatility. The method aids in the optimization of healthcare business operations as well as patient safety.

The core results and recommendations for optimizing the performance of the system's operation and automation are presented in the conclusion.

Keywords*— *Information Systems, e-workflow, Medicine, IT in Medicine, e-health

I. INTRODUCTION

Originally, computers were primarily intended to perform complex mathematical calculations (especially for calculations related to nuclear weapons and missile technology); currently the dominant direction is the accumulation and processing of information. This redistribution of the main functions performed by the computer technology is quite clear - the civil business is much more widespread than the military, and scientific computing, and reduce the cost of computers has made them available for very small businesses and even individuals [1-3].

Today the management of the enterprise is simply inconceivable without a computer. Management, payroll, warehouse management, assortment, and sourcing are all sectors where computers have a long and solid presence [4]. The modern industry, on the other hand, necessitates a far greater usage of information technology in the management of the company [5]. Since modern enterprise is extremely vulnerable to management mistakes, computer technology's viability and growth are critical. Being first needs more than intuition, supervisory expertise, and money [6]. Various facets of financial and economic practices, such as trading, manufacturing, or the provision of any facilities, should be held under the supervision of qualified administrative decisions under confusion and danger [7-9]. As a result, investing in information technologies is essential for a new management strategy. Furthermore, the larger the company, the more related attachments there should be. They're a must-have; in a tight race for first place, only the best-equipped and well-organized team can emerge victorious [10].

Automation of business processes in health care includes data about physicians, patients, hospitals are required to operate clinics. The database allows you to add, edit, search, and delete data, and view the data [11].

The relevance of this topic is that in this age of information technology, it has become really to convert all documents into electronic form.

Goal: To collect data and automate business processes in hospitals.

Hospital activities consist of:

- Reception of patients
- Assignment of courses of treatment
- Consultation of physicians

The main objectives will be creating the website with the following features:

For medical personnel:
1. Building a medical card for patient
2. Create appointment
3. Create analysis
4. View data of patient
5. Create the reference

For patients:
1. View profile
2. View illness history
3. View appointments
4. View analysis
5. View References

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In addition, service will have the opportunity to integrate with other systems by providing the API

II. BUSINESS PROCESSES IN HOSPITALS

A. *Business process in the hospital*

The objectives of the project for the creation and implementation of an integrated access control system are improving the quality of service and the overall loyalty of Polyclinic patients, increasing the level of security of the institution, increasing the profitability of medical services [12-14].

In the current stage, we model the Database of the medical center. There will be given a short explanation for the business process of medical center.

There will be list of countries. Each country will have a list of cities, which belongs to it. Each medical center will belong to the specific country and city. Each of them will have its own addresses and each address will have the postcode. Each organization (medical center) will have the several departments, which will include healthcare center personal.

When the patient firstly comes to the healthcare center the manager (may be a doctor) of the center will register the patient to the system and give him the unique id and password, which may be used by him or she further to see the private data, ill-ness history, doctors and appointments which were made by them and medicines. The doctor can send the patient to the different doctors. Each doctor may see the full data about the patient if the patient was references to that doctor. Also the doctor may make appointments to the patient, recommend medicines. The doctor can leave feedbacks for illnesses, appointments, medicines, and for the patient.

B. *The System Architecture*

Fig. 1 illustrates an architecture of the system.

The whole system includes the database, ORM, Unit Testing, web system, mvc.

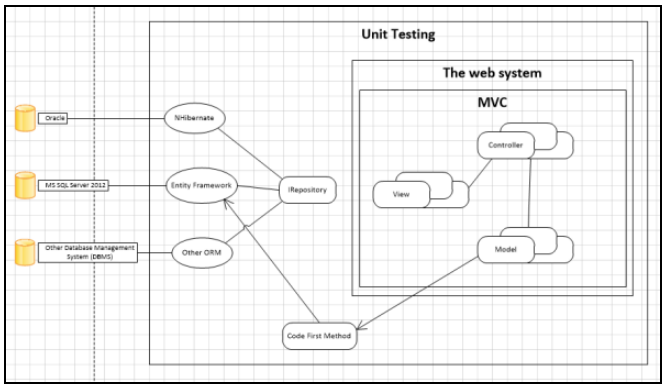

Fig. 1. Architecture of the system

C. *Database Structure*

Entity relationship diagram of the database is provided in the Fig. 2. The 3-rd normalization was used during the designing of the database.

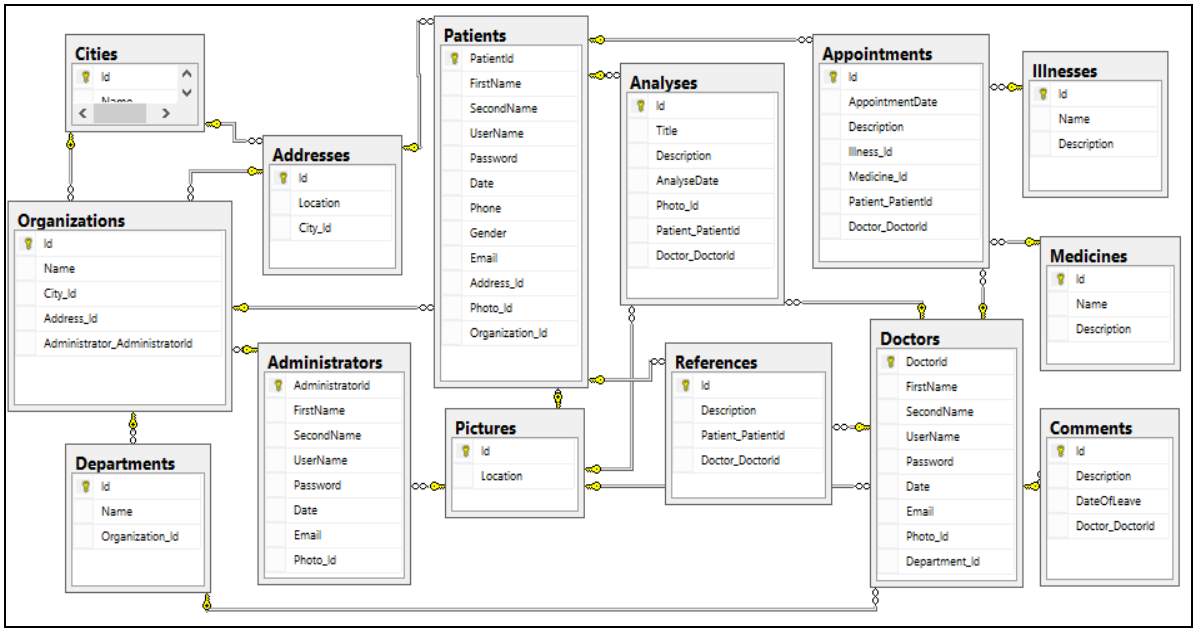

Fig. 2. ER Diagram

D. *Use Case Diagrams*

In Fig. 3 the use-case diagram of the actors is shown. The system will have the five actors. They are: Doctor, Government, Administrator and Patient. All of them have the action log in, which includes validate user, which will check users from the database. If they successfully logged in each of them has their own use-case diagrams.

E. *Use Case of a Doctor*

In Fig. 4 the use-case diagram of the doctor who have logged in successfully is shown. After the successfully entering the system, the doctor may see the patients' list who are in the queue of the doctor. Each of the patient in list will include the medical card.

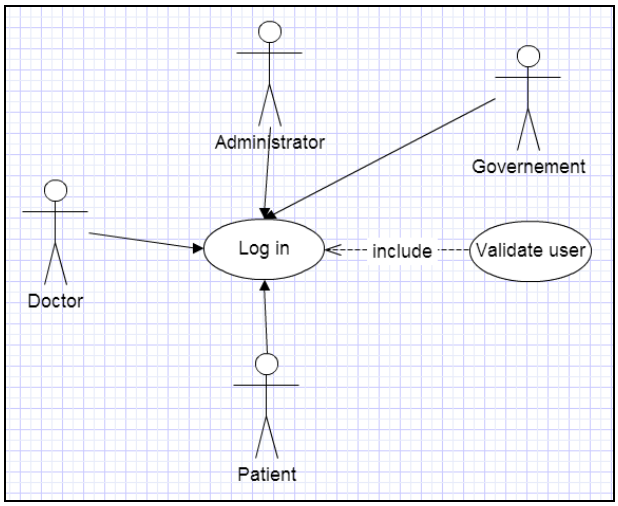

Fig. 3. Use case diagram of roles

The doctor may see the full information that includes the medical card. Exactly the doctor can see the patient illness history, patient's analyses, write reference, create analyses and create illness. If the doctor will create the illness, the doctor may create appointment, create specific illness and appoint medicines. One more thing what can do the doctor is see appointment list which he or she received. For each of them the doctor can write the feedback.

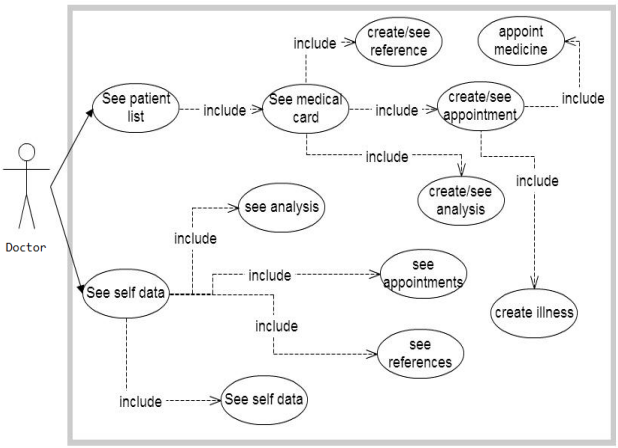

Fig. 4. Use case diagram of a doctor

F. Use Case of the Gorvernment

If the user is government, for them will be available data for auditing. For further analysis and statistics. They will have all privileges to data. The use case of the government is shown in Fig. 5.

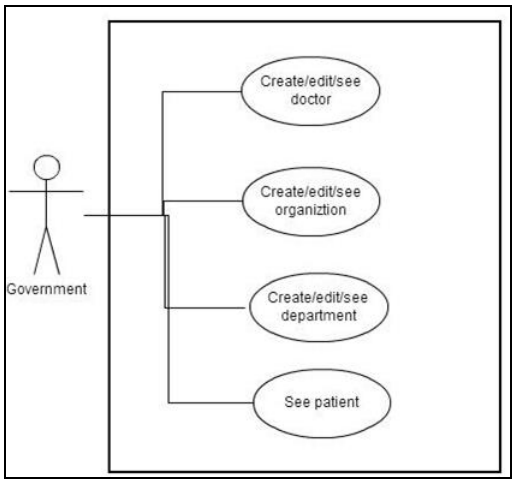

Fig. 5. Evolution of mobile standards

G. Use Case of Administrators

Each organization will have only one administrator. This administrator will have an access to all data which belongs to this organization. The administrator will have an opportunity to create the doctors and departments. They will not have an ability to change data of the already created appointment, analyses and references. All of them will be done on the government level. The use case diagram of the administrator is shown in Fig. 6.

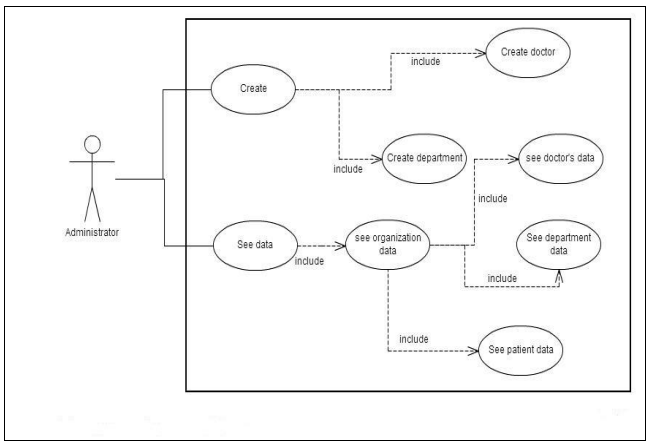

Fig. 6. Evolution of an administrator

H. Use Case of a Patient

In Fig. 7 the use case diagram of the patient is shown. If the user is patient the patient can see the organization list with addresses. See each hospital schedule. Also the patient can see the departments of the organization. See department doctors list. See the department doctor. By selecting the doctor from the list the patient gives the permission to the doctor to see his or her medical card. This type of giving permission will prevent being public the private data of the patient.

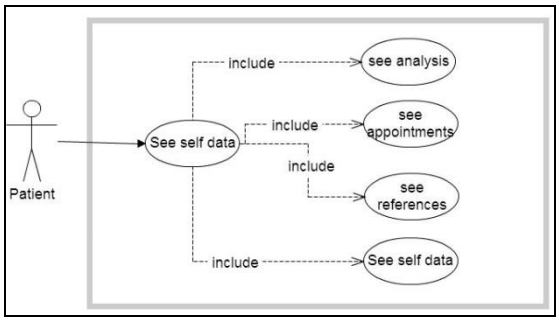

Fig. 7. Evolution of a patient

III. IMPLEMENTATION

A. *MVC, Classes, Functions*

In the diploma project the MVC design pattern was used. Using the CF modeling the database was created. Through CF the models(classes) was created. Then according to this classes controller, which will handle the model data, was created.

Then the view was created for browsers to display the information. At the picture below the MVC of the system is shown. In the controller the AdministratorController is responsible for all actions which are related to the administrator. The PatientController is responsible for all patient's actions. The DoctorController is responsible for all action's which are related to doctor. HomeController is responsible for all actions, until the user is logged in. The UserRoleController is responsible for assigning the roles in the system if the user is patient, administrator or doctor. The MVC classes are shown in Fig. 8.

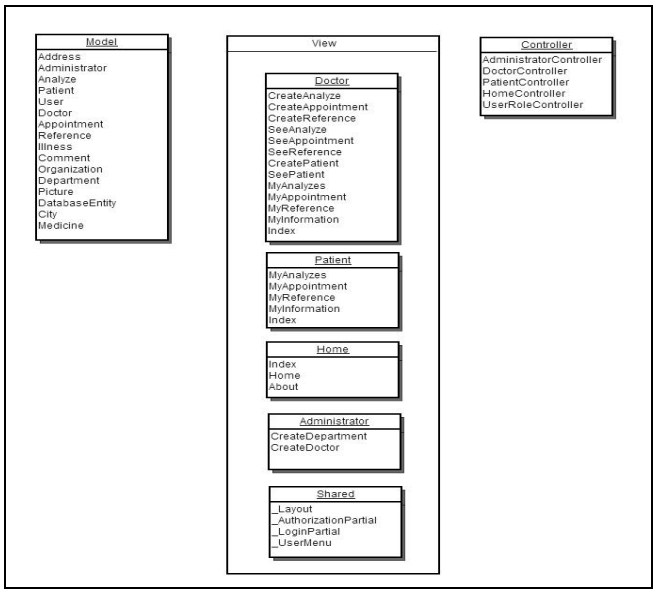

Fig. 8. Model, View, Control

In Fig. 9 is the UML class diagram of this system. This diagram shows only the relationships between classes.

In this system, there are 4 layers of hierarchy. They are:

1) Patient

2) Doctor

3) Administrator

4) Government

Government can create organizations (medical centers, hospitals etc.). Also they can see all information in the database. Additionally they can edit all data which are in the database. They can create administrators and assign them to each hospital. Each hospital can have only one administrator.

Only one administrator can be assigned to one hospital. This administrators can create a new department in the hospital. Add new doctors to the database. Adminis-trator during the addition of doctor, they must assign them to one department. Ad-ministrator can see all information, which are related to he/her department.

Doctor can be assigned only by administrator of the organization. Doctor must be assigned to one department. All doctors have a list of references, appointments, ana-lyzes. Also they can create patients, and see their information too.

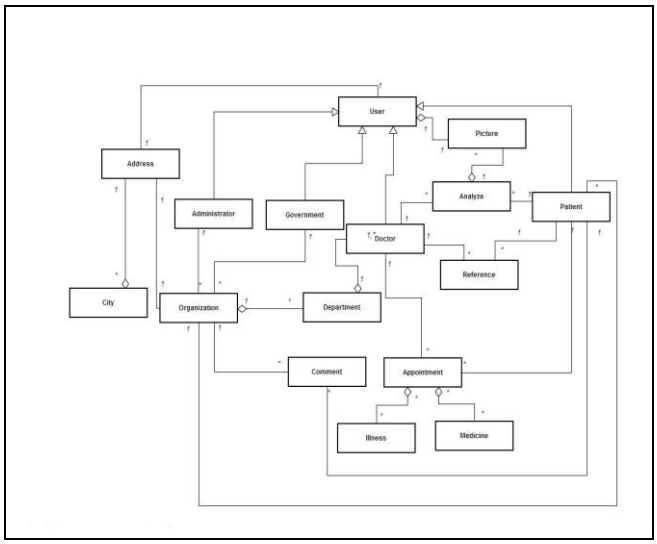

Fig. 9. UML class diagram

Patient can only see the information which are related to them.

Each user has his/her first name, second name, username, password, birthday, email and photo. All of the parameters are string except birthday and Photo. Birth-day's type is date and photo's is Picture. The function User() is the default construc-tor. It is used to create an instance of the class User.

Each of the roles have their own individual characteristics. The patient has the list of references, list of appointments and list of analysis. The doctor has the list of analysis, appointments, references which they have appointed to patient. The admin-istrator has the list of departments.

The patient has the following functions in the current diploma project:

1) MyInformation

2) MyAppointment

3) MyAnalyzes

4) MyReferences

IV. Results

The start page is the Index page in the Home folder. In the start page there is the form. The start page's form is shown in the Fig. 10.

Fig. 10. Authorization

The user to enter to the system must enter the username to the textbox under the label "User name" and password to the textbox under the label "Password". Then if the user wants to sign in automatically each time when he/she opens the web site, the user must select the checkbox near the label "Remember me". Then the user have to choose who is he and select one of the radio button for what it belongs to. For example: if user wants to sign in being Patient, in that case the user have to choose radio button near the label "Patient".

If the user is patient then opens the start page of the patient. This page is the view which is located in the Patient folder in the Views folder. At the start page of the patient there appears the menu. The menu is shown in the Fig. 11.

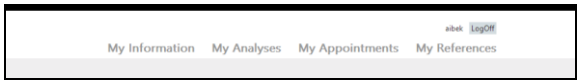

Fig. 11. Patient's menu

When patient click "MyInformation" then the patient will get his or her own information. The page of the "My Information" is shown in Fig. 12

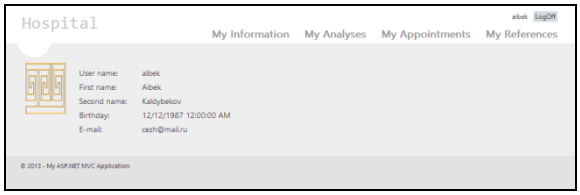

Fig. 12. My information page

When the user clicks to the link "Create Patient" there will appear the form which must be filled by the doctor. The page is shown in the Fig. 13.

Fig. 13. My information page

There will appear the list of the patients. Under each of the patient's information appear the links. They are "Create analysis", "See analysis", "Create Appointment", "See Appointments", "Create reference", "See references". In create analyze link will appear the form then it must be completely filled then it will be created. After the creating of analysis can be seen in the "See analysis" link. This algorithm is same for appointment and references.

In each of the roles have the index pages (see Fig. 14) where they can see the noti-fications. For example the patient may see the information about the time of their getting drug. Information about epidemic or what to do in urgent situations. This will help patients to know more about the medicine. The doctors may get the information about the new methods of curing. The latest news in the medicine etc.

Fig. 14. Index

V. Conclusion

To sum up, during the diploma project work was done the automation of business processes in medical centers by analyzing the hospitals. This project solves many problems like bureaucracy, waste of time, digitalization of all data, duplicating of medical cards of patients etc. There are not any analogues of this project in our country. The main idea of this project is to centralize the database, where will be stored all data of the patients. Through this, there will be only one medical card for one people. The medical center worker will have an opportunity to see the full history of the patient by requesting to the database. Throughout this, all doctors will have more time.

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