

The application based on google maps API to find and manage blood donation volunteers

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ABSTRACT

Most young Vietnamese people now have access to the movement of voluntary blood donation. Volunteers who want to donate blood must meet certain health requirements and wait at least three months between donations. As a result, the blood received falls below the bare minimum, resulting in reserve anemia. Based on these practical requirements, the article proposes a tool to assist health facilities in locating people willing to donate blood in hazardous situations within a reasonable distance. This system is built on a three-layer model that interacts with the database via Entity Framework and uses the Google Map API to locate blood donors. Before being used, the application was tested on a website using blood donation data from volunteers in the Binh Thanh and Go Vap districts.

1. Introduction

Today, the voluntary blood donation movement in Vietnam has reached the vast majority of young people. Volunteers who want to donate blood need to meet the health requirements, and the minimum time between two blood donations should be at least three months. However, the amount of blood received still does not meet the required blood volume. The Vietnamnet.vn newspaper analyzed the severe anemia in some hospitals (Thuy Hanh, 2018). Mr. Pham Tuan Duong - Deputy director of the National Institute of Hematology and Blood Transfusion - said that the amount of group O blood in reserve at the institute is only nearly 2,000 units (Thai Ha, 2019). On average, the Institute needs at least 500 - 700 units of type O blood daily to supply emergency and treatment needs at 180 hospitals in Hanoi and the northern provinces, with 2,000 units of type O blood. Existing can only respond in the next couple of days. Tien Phong's online newspaper continues to publish more articles highlighting that anemia in some major hospitals in the North, such as Viet Duc Hospital, National Hematology, and Blood Transfusion, is at an alarming rate (Thai Ha, 2019).

Blood donation is not uncommon around the world; each country has its blood donation campaign. Since then, the blood donation registration system has been gradually built with the goal of helping to improve anemia and providing convenience to blood donors. NHS Blood and Transplant has built and developed a blood donation system in the United Kingdom (NHSBT) (Ferguson et al., 2020). This system is built for the web as well as mobile applications for two operating systems: iOS and Android. This system was developed to support blood donation and transplant services in the United Kingdom, making blood donation more convenient.

In Vietnam, the National Institute of Hematology and Blood Transfusion collaborated with Viettel to develop the "Blood Donation" mobile application (National Institute of Hematology and

Blood Transfusion, 2020b). This application allows blood donors to look up information about blood donation, blood donation locations, hospital blood needs, convenient blood donation registration, a detailed history of blood donations, and so on.

Based on these practical requirements, the paper proposes a tool to aid in managing of voluntary blood donation. This application will assist volunteers in actively registering to donate blood. Based on the information registered by the blood donor, the hospital can manage the information of the blood donors and control the amount of blood received each day in the hospital through voluntary blood donation. If the hospital’s blood supply is about to run out, the system administrator will conduct a search for suitable blood donors, then contact and schedule an appointment at the nearest hospital to conduct tests and take blood.

This research direction contributes to the hospital actively contacting blood donors when the type is about to run out, reducing anemia. As a result, a blood group can be quickly provided to the patient so that the hospital can treat and cure the patient. Blood donors can view their blood donation history to determine how long they can continue to donate blood. The initiative from both sides of the hospital and blood donors will help reduce the blood shortage.

The remainder of the paper is structured as follows: Part 2 discusses theories related to research content, such as the blood donation process in Vietnam, how to use the three-layer model in programming, and how to interact with databases using Entity Framework. Part 3 contains a detailed analysis of the system design. Part 4 describes the application development process, which is based on the results of the system design analysis discussed above. Section 5 depicts the application testing- section 6’s content results from building the application and determining the development path.

2. Theoretical research foundation

2.1. Some regulations on blood donation in Vietnam

Human blood is divided into four main groups: O, A, B, and AB. Each blood group has its characteristics; the structure of blood vessels can be broken if the blood type is incompatible. The hematology chart stipulates the basic donor and recipient blood groups (Jibawi, Baguneid, & Bhowmick, 2018), as shown in Figure 1.

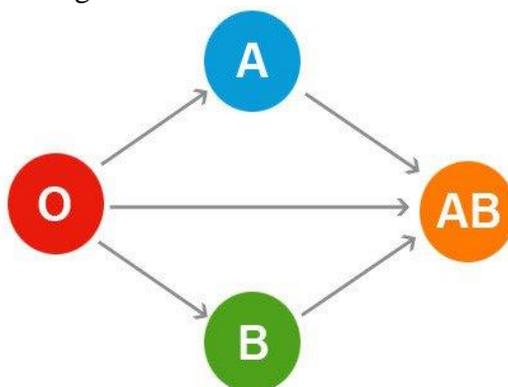


Figure 1. Hematology chart specifying the basic donor and receiving blood group

Humane blood donation not only saves lives but also provides numerous health benefits to donors, such as lowering the risk of hemochromatosis (a disorder in which too much iron is absorbed), lowering the risk of cancer, lowering the risk of cardiovascular disease, producing new blood cells, and so on. In Vietnam, voluntary blood donors can receive gifts from November 1, 2018, through medical examinations and treatment services. Patients are given gifts in proportion to the volume of blood donated.

In Vietnam, the blood donation process consists of five steps: registering for a health examination consultation; a health check-up; a rapid blood test; donating blood and resting; and receiving a certificate after donating blood.

A volunteer who wishes to register to donate blood must meet the following criteria: between the ages of 18 and 60; Have a good mental and physical state; weigh at least 42kg for females and 45kg for males; Last blood donation: 12 weeks or more ago; not infected with or at risk of contracting HIV; free of hepatitis B and blood-borne viruses; no cardiovascular, blood pressure, respiratory, or stomach diseases (National Institute of Hematology and Blood Transfusion, 2020a).

2.2. Three-layer model

Figure 2 depicts the structure of the three-layer model, which is made up of presentation layers, business layers, and data layers (Mueller, 2013). These classes will communicate with each other through the services that each layer provides to create the application.

Each class has a child component and its role. The three-layer model is depicted in Figure 2:

Presentation Layers: communicate with end users to collect data and display results and data via user interface elements. This class has two main components: user interface components and user interface process components.

Business layers: perform the system's main operations, use the data access layer's services, and provide services to the presentation layer. This layer can also use the services of third-party providers to complete its tasks. The main components in this class are business components, business entities, and service interfaces.

Data Layers: perform operations related to storing and retrieving data from the application. This class has three main components: Data Access Logic (DAL), data sources, and service agents.

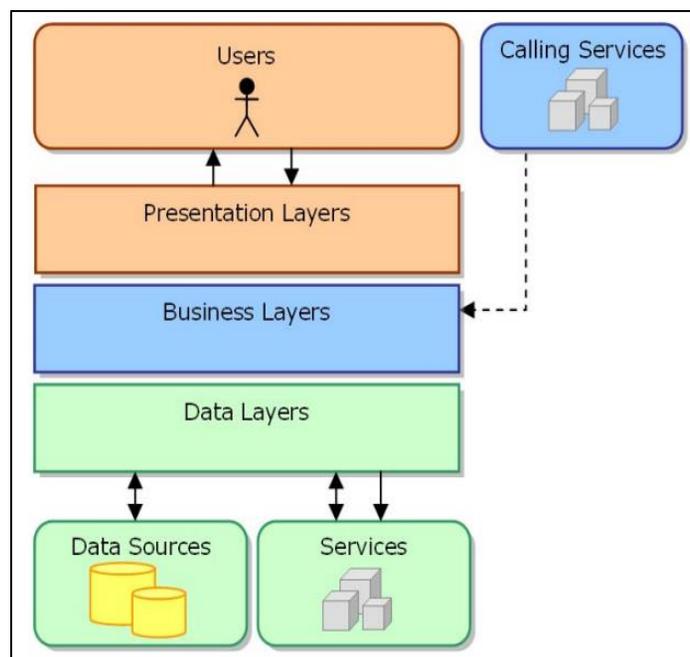


Figure 2. The 03-layer architecture model

2.3. Entity framework

ADO.NET Entity Framework is a platform used to work with databases through an object-relational mapping mechanism (Mueller, 2013). As a result, it is possible to query and manipulate

the database indirectly through programming objects. The architecture of Entity Framework consists of three components, as shown in Figure 3, including:

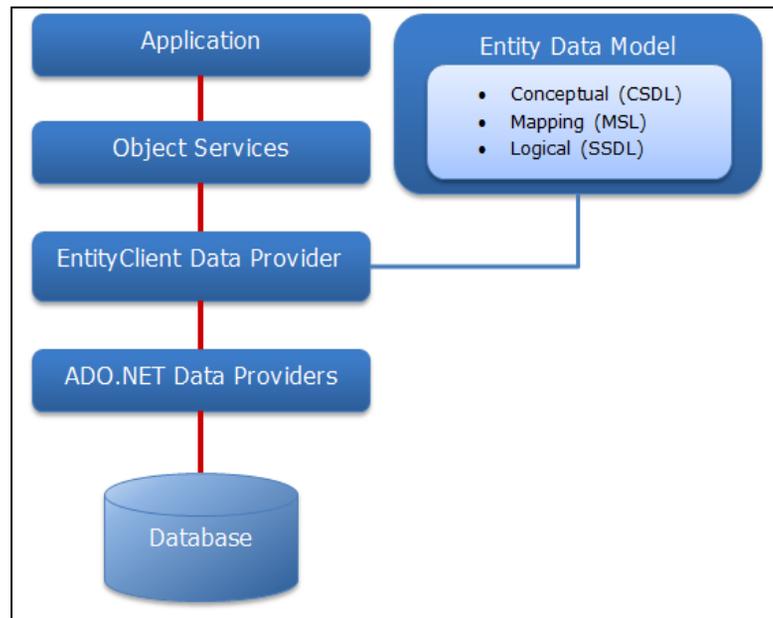


Figure 3. Entity framework architecture

There are three approaches to Entity Framework (Tenny & Tenny, 2010):

Database First: This is usually supported since Entity Framework 1 in Visual Studio 2008. Entity Framework will automatically create classes (object layers) from the database available through the Entity Data Model Wizard tool, which you can change and update back into the database. This is a popular approach because of its simple, fast implementation.

Model First: This approach is added to the Entity Framework 4 version in Visual 2010, where it is possible to create an empty data model using the Entity Data Model Designer tool, and then the object layer is also automatically generated. After designing, use the Generate Database from Model function to generate DDL (data dEntity Framework initial language) codes from SSDL (Store Schema DEntity Framework initial language). These DDL commands will be run and saved as a.sql file.

Code First: This approach skips the model (.edmx) section and allows you to create classes corresponding to the database tables you want to work with or create. With this approach, use the DbContext class instead ofObjectContext to manipulate the database. Using Code First requires manual work but is flexible and widely used.

2.4. Google map API

Google Maps is a free web-based map application provided by Google. It is possible to embed third-party websites using the GMapsle Map API. It has a plethora of advanced utilities to assist users in finding directions, locations, landmarks, and so on. Google Maps API is created for four main purposes: Android applications, iOS applications, web applications, and web service applications.

Map API is a method that allows website B to use the map service of website A and embed it on its website. Site A here is a Google Map, and site B is an individual or organization website that wants to use Google's services (hover, zoom, mark on the map, etc.). Applications built on maps are embedded into personal web pages via JavaScript tags, so using Google APIs is easy.

Google Maps API version 3 now supports traditional desktops, and mobile devices, are faster and support more applications.

3. System design analysis and application development

3.1. System functional diagram

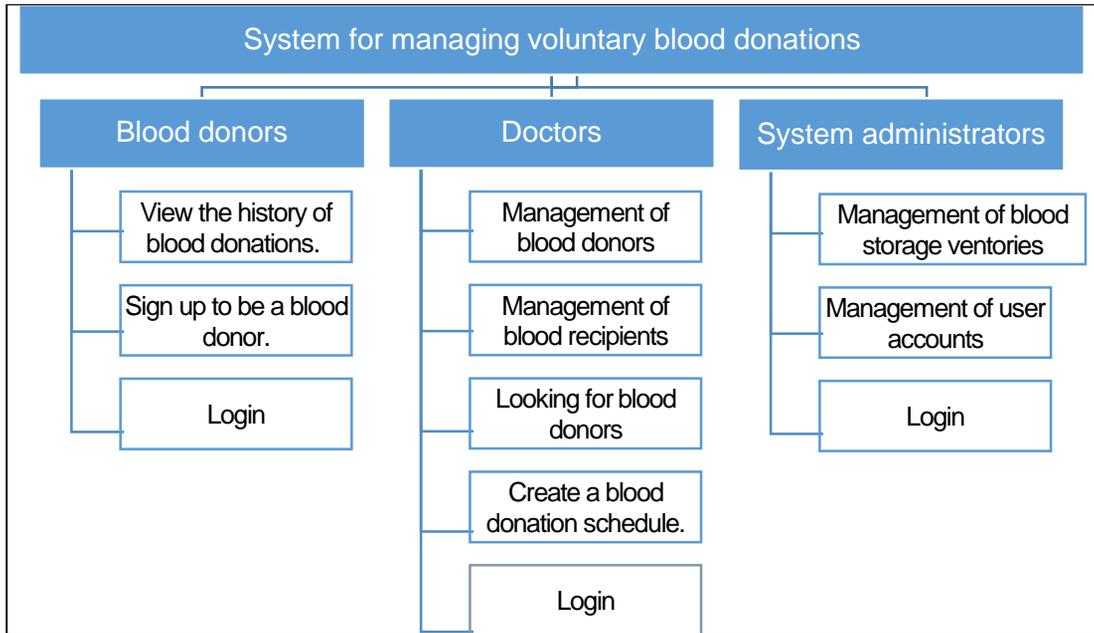


Figure 4. Diagram of system functionality

The system manages only blood donations from medical units affiliated with the system. As shown in Figure 4, the system is designed for three types of users: blood donors, blood donation managers in medical units (collectively referred to as “doctors”), and system administrators. The system has two main functions: finding qualified blood donors and creating blood donation schedules. In addition, the system performs some other essential basic functions, such as blood donor management, blood donation history, blood inventory management, and user account management.

3.2. The process of finding blood donors

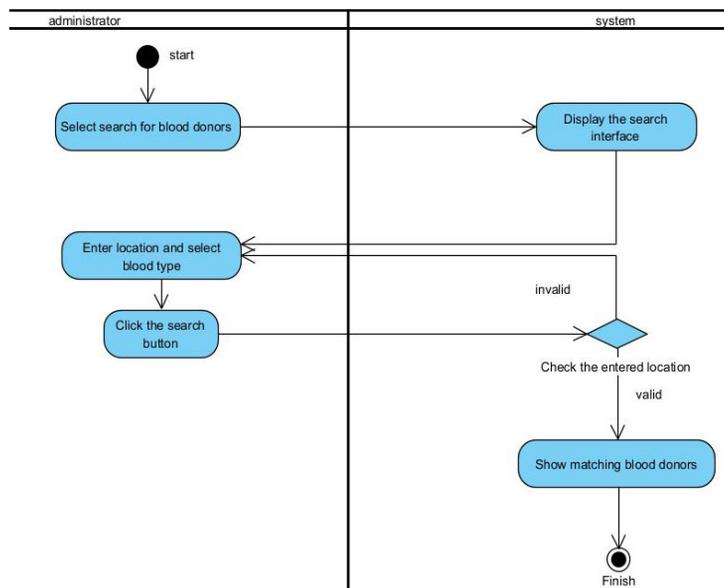


Figure 5. The process of searching for blood donors

The diagram above depicts the process of locating blood donors. When the manager needs to find volunteers to donate blood, he or she will select “Search for blood donors,” The system will display the blood donor search interface. The manager will enter the necessary information, including the blood type. The system will generate a list of people with matching blood types. Administrators can choose and contact volunteers to set up blood donation schedules.

The appropriate blood group is chosen using the blood group compatibility table below:

Table 1

Table of blood group compatibility for donor and recipient

Blood recipient	Blood donors							
	O-	O+	A-	A+	B-	B+	AB-	AB+
O-	✓	✗	✗	✗	✗	✗	✗	✗
O+	✓	✓	✗	✗	✗	✗	✗	✗
A-	✓	✗	✓	✗	✗	✗	✗	✗
A+	✓	✓	✓	✓	✗	✗	✗	✗
B-	✓	✗	✗	✗	✓	✗	✗	✗
B+	✓	✓	✗	✗	✓	✓	✗	✗
AB-	✓	✗	✓	✗	✓	✗	✓	✗
AB+	✓	✓	✓	✓	✓	✓	✓	✓

3.3. The process of creating a blood donation schedule

Figure 6 depicts the blood donation schedule creation process: when a blood donation schedule is required so that volunteers can register to donate blood online, the manager will select “Create a blood donation schedule,” and the system will display an interface to create a new blood donation schedule, and the manager will fill in the required information, which is the blood donation schedule’s start and end dates and times. The system will validate the input data and save the newly created blood donation schedule in the database if it is valid.

Volunteers will see “the created blood donation schedule” after creating a blood donation schedule. Volunteers can register to donate blood if they want to participate in blood donation.

3.4. Some other basic functions

Figure 7 depicts the process of adding new blood donors: when a new blood donor donates blood for the first time at the hospital, the administrator enters the donor’s information into the system. The manager will navigate to the “Manage Blood Donors” function and click the “Add New” button. The system will display the interface for adding a new blood donor; the manager will enter the information and press the “Add” button; the system will validate the input data; and the system will save the sending information for adding blood to the database.

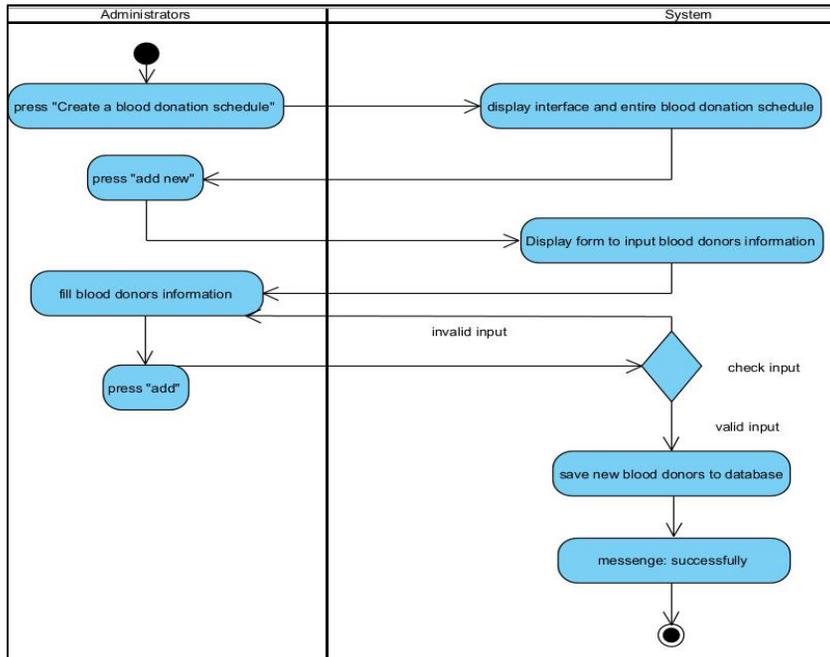


Figure 6. The process of creating a blood donation schedule

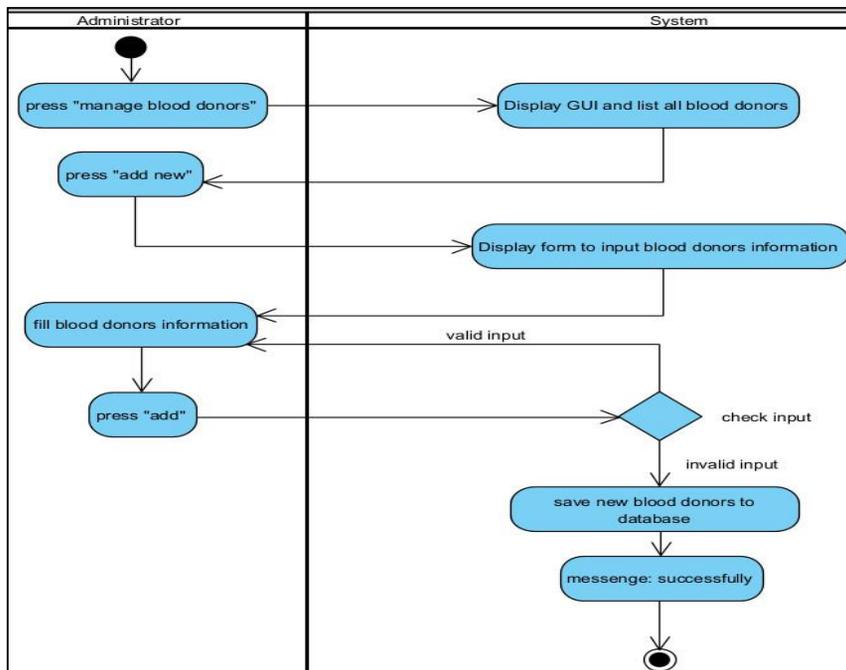


Figure 7. The process of adding new volunteers

After successfully adding a new blood donor, the donor will be assigned a login account with the login name serving as the identity card, allowing the donor to log in to the system, register to participate in blood donation using the registration form calendar created, and view their blood donation history.

When an administrator needs to view a blood donor’s blood donation history, the process is depicted in Figure 8. When the manager selects “View blood donation history,” the system displays all blood donors’ entire blood donation history. The manager enters the information to see if there is data that matches what was entered, and the system displays the results to the administrator.

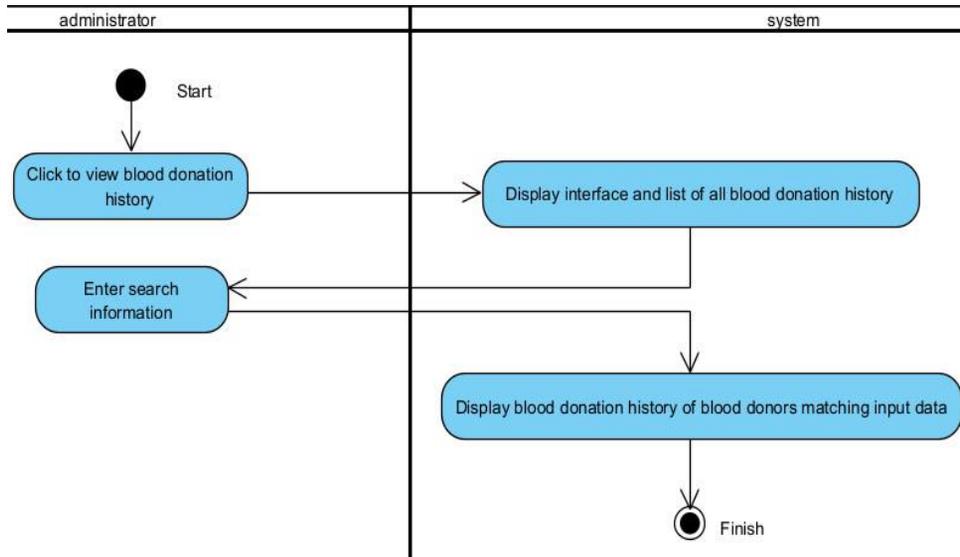


Figure 8. The process of viewing blood donation history

3.5. Building applications

The application is implemented on computers with a Core i5 processor, 8 GB of main memory, and the Windows 10 operating system. The system is built on a 3-layer model using the C# programming language and interacts with the base. The SQL Server database management system stores data. The system performs basic functions such as managing blood donors, viewing blood donation history, managing blood storage, and searching for blood donors who meet the search criteria. The basic functions of the system are shown in Figure 9-12.

Figure 9 shows a list of volunteers with suitable blood types to donate blood to group A+, with the distance is the circle's radius and the center at 241 Nguyen Thai Son, Go Vap District, Ho Chi Minh City. The list is sorted by distance, from smallest to largest, which means that the most likely person to donate blood is closer to the specified location.

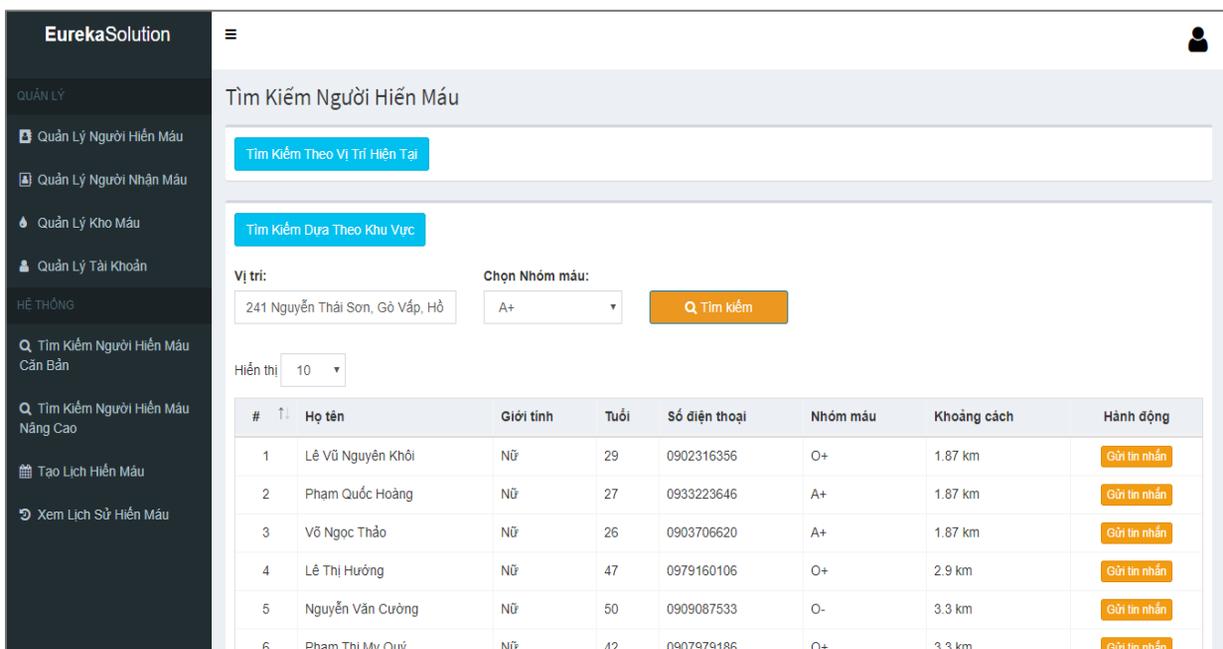


Figure 9. Searching for blood donors interface

EurekaSolution

QUẢN LÝ

- Quản Lý Người Hiến Máu
- Quản Lý Người Nhận Máu
- Quản Lý Kho Máu
- Quản Lý Tài Khoản

HỆ THỐNG

- Tìm Kiếm Người Hiến Máu Căn Bản
- Tìm Kiếm Người Hiến Máu Nâng Cao
- Tạo Lịch Hiến Máu
- Xem Lịch Sử Hiến Máu

Xem lịch sử hiến máu

Hiện thị: 10

Tìm kiếm:

#	Tên người hiến máu	Chứng minh nhân dân	Nhóm máu	Tên bệnh viện	Ngày hiến máu	Cách ngày hiến tại
1	Nguyễn Văn An	215485232	AB+	Đại học Công nghiệp Hồ Chí Minh	01/06/2019	47 Ngày
2	Tô Thanh Tùng	215485221	B+	Đại học Công nghiệp Hồ Chí Minh	01/06/2019	47 Ngày
3	Đỗ Đình Trung	257945821	A+	Đại học Công nghiệp Hồ Chí Minh	25/05/2019	54 Ngày
4	Đặng Ngọc Yến	214587423	A-	Đại học Công nghiệp Hồ Chí Minh	15/05/2019	64 Ngày
5	Phạm Thị Mỹ Phương	214785985	B+	Đại học Công nghiệp Hồ Chí Minh	04/05/2019	75 Ngày
6	Nguyễn Văn Vĩnh	214523012	A-	Đại học Công nghiệp Hồ Chí Minh	30/04/2019	79 Ngày
7	Phạm Vũ Sơn Hòa	254829562	A+	Đại học Công nghiệp Hồ Chí Minh	22/04/2019	87 Ngày
8	Phạm Thị Dung	214585652	B+	Đại học Công nghiệp Hồ Chí Minh	22/04/2019	87 Ngày
9	Trương Thị Quý	217864236	B+	Đại học Công nghiệp Hồ Chí Minh	15/04/2019	94 Ngày
10	Nguyễn Thúy Hà	254895698	O-	Đại học Công nghiệp Hồ Chí Minh	05/04/2019	104 Ngày

Trang 1/5

Trước 1 2 3 4 5 Sau

Figure 10. Viewing blood donation history interface

EurekaSolution

QUẢN LÝ

- Quản Lý Người Hiến Máu
- Quản Lý Người Nhận Máu
- Quản Lý Kho Máu
- Quản Lý Tài Khoản

HỆ THỐNG

- Tìm Kiếm Người Hiến Máu Căn Bản
- Tìm Kiếm Người Hiến Máu Nâng Cao
- Tạo Lịch Hiến Máu
- Xem Lịch Sử Hiến Máu

Quản Lý Kho Máu

Hiện thị: 10

#	Nhóm máu	Thể tích hiện có	Ghi chú	Hành động
1	A+	9000 ml	Nhóm máu đang thiếu	Tìm kiếm người hiến máu
2	A-	20000 ml	Còn đủ dự trữ trong bệnh viện	Tìm kiếm người hiến máu
3	AB+	11000 ml	Còn đủ dự trữ trong bệnh viện	Tìm kiếm người hiến máu
4	AB-	7000 ml	Nhóm máu đang thiếu	Tìm kiếm người hiến máu
5	B+	5000 ml	Nhóm máu đang thiếu	Tìm kiếm người hiến máu
6	B-	40000 ml	Còn đủ dự trữ trong bệnh viện	Tìm kiếm người hiến máu
7	O+	24000 ml	Còn đủ dự trữ trong bệnh viện	Tìm kiếm người hiến máu
8	O-	23000 ml	Còn đủ dự trữ trong bệnh viện	Tìm kiếm người hiến máu

Trang 1/1

< 1 >

Figure 11. Managing blood inventories interface

EurekaSolution

QUẢN LÝ

- Quản Lý Người Hiến Máu
- Quản Lý Người Nhận Máu
- Quản Lý Kho Máu
- Quản Lý Tài Khoản

HỆ THỐNG

- Tìm Kiếm Người Hiến Máu Căn Bản
- Tìm Kiếm Người Hiến Máu Nâng Cao
- Tạo Lịch Hiến Máu
- Xem Lịch Sử Hiến Máu

Quản Lý Người Hiến Máu

[+](#)
Thêm mới

Hiện thị: 10

#	Tên người hiến máu	Ngày sinh	Tuổi	Số điện thoại	Chứng minh thư	Địa chỉ	Phường/ Xã	Quận/ Huyện	Tỉnh/ Thành phố
21	Nguyễn Đức Hùng	10/06/1966	52	0908480744	245856985	148/44A Nguyễn Lâm	Phường 7	Quận Phú Nhuận	TP.Hồ Chí Minh
22	Phạm Thị Dung	10/06/1968	50	0932653811	214585652	156/12 Nguyễn Lâm	Phường 7	Quận Phú Nhuận	TP.Hồ Chí Minh
23	Nguyễn Ngọc Thu Tâm	11/06/1984	34	0909521184	248547851	23 Vạn Kiếp	Phường 3	Quận Bình Thạnh	TP.Hồ Chí Minh
24	Lê Thị Dương Ngọc	10/06/1974	44	0902423915	245856589	67/4/403 Vũ Huy Tấn	Phường 3	Quận Bình Thạnh	TP.Hồ Chí Minh
25	Nguyễn Thúy Hà	16/06/1973	45	0983201391	254895698	35 Trần Kế Xương	Phường 6	Quận Phú Nhuận	TP.Hồ Chí Minh
26	Phạm Thị Mỹ Phương	25/06/1964	54	0963963928	214785985	12/17A Phan Đăng Lưu	Phường 7	Quận Bình Thạnh	TP.Hồ Chí Minh
27	Nguyễn Văn Cường	27/06/1968	50	0909087533	247956253	148/44 Nguyễn Lâm	Phường 7	Quận Bình Thạnh	TP.Hồ Chí Minh
28	Nguyễn Quang Việt	10/06/1980	38	0912729922	254785123	23 Vạn Kiếp	Phường 3	Quận Bình Thạnh	TP.Hồ Chí Minh
29	Nguyễn Thị Mỹ Trinh	26/06/1969	49	0967083139	248921452	125/5 Đinh Tiên Hoàng	Phường 3	Quận Bình Thạnh	TP.Hồ Chí Minh

Figure 12. Managing blood donors' interface

4. Test case

After analyzing and building the system, the author collected data from volunteers who donated blood to test its functions before deploying it. The test data used is that of 60 volunteers from Binh Thanh District and Go Vap District who has registered to donate blood voluntarily at the Red Cross Society of Binh Thanh District and 100 students from the Industrial University of Ho Chi Minh City. Table 2 depicts the testing of some basic system functions.

Table 2

Test case

Function	Scenario	Steps	Data	Expected results
Looking for blood donors	Check for blood donors by current location	<ol style="list-style-type: none"> 1. Log in to the system 2. Select the function “Search for blood donors” 3. Determine your blood type 4. Press the Search button 	Blood Type: B+	There were 17 blood donors who could donate blood for blood group B +
	Check for blood donors by region	<ol style="list-style-type: none"> 1. Log in to the system 2. Select the function “Search for blood donors” 3. Enter the area location 4. Choose your blood type 5. Press the Search button 	Location: 241 Nguyen Thai Son, Go Vap, Ho Chi Minh City Blood Type: B-	There were 04 blood donors who could donate blood for blood group B -
		<ol style="list-style-type: none"> 1. Log in to the system 2. Select the function “Search for blood donors” 3. Enter the area location 4. Choose your blood type 5. Press the Search button 	Location: “” Blood Type: B-	Announcement: “Please enter coordinates”
Blood donor management	Adding new blood donors	<ol style="list-style-type: none"> 1. Log in to the system 2. Select the function “Manage blood donors” 3. Click the “Add New” button 4. Enter the following test data: full name, date of birth, phone number, address, identity card number, email, and blood type 5. Press the “Add” button 	Last name: “Tran Van” Name: “Bao” Date of Birth: “1997-05-14” Phone number: 0987282756 Province/City: “Ho Chi Minh City” District: “Phu Nhuan District” Ward/Commune: “Ward 3” Address: “13 Dinh Tien Hoang” ID: “215408632” Email: “luannh@gmail.com” Blood Type: “AB+”	Announcement “Adding a new successful blood donor”
		<ol style="list-style-type: none"> 1. Log in to the system 2. Select the function “Manage blood donors” 3. Click the “Add New” button 4. Enter the following test 	Last name: “Tran Van” Name: “Bao” Date of Birth: “1997-05-14” Phone number: 0987282756 Province/City: “Ho Chi Minh City”	Announcement “Invalid ID Card Number”

Function	Scenario	Steps	Data	Expected results
		data: full name, date of birth, phone number, address, identity card number, email, and blood type 5. Press the "Add" button	District: "Phu Nhuan District" Ward/Commune: "Ward 3" Address: "13 Dinh Tien Hoang" ID: "abc123" Email: "luannh@gmail.com" Blood Type: "AB+"	
		1. Log in to the system 2. Select the function "Manage blood donors" 3. Click the "Add New" button 4. Enter the following test data: full name, date of birth, phone number, address, identity card number, email, and blood type 5. Press the "Add" button	Last name: "Tran Van" Name: "Bao" Date of Birth: "1997-05-14" Phone number: "abc123" Province/City: "Ho Chi Minh City" District: "Phu Nhuan District" Ward/Commune: "Ward 3" Address: "13 Dinh Tien Hoang" ID: "215408632" Email: "luannh@gmail.com" Blood Type: "AB+"	Announcement "Invalid Phone Number"
		1. Log in to the system 2. Select the function "Manage blood donors" 3. Click the "Add New" button 4. Enter the following test data: full name, date of birth, phone number, address, identity card number, email, and blood type 5. Press the "Add" button	Last name: "Tran Van" Name: "Bao" Date of Birth: "1997-05-14" Phone number: 0987282756 Province/City: "Ho Chi Minh City" District: "Phu Nhuan District" Ward/Commune: "Ward 3" Address: "13 Dinh Tien Hoang" ID: "215408632" Email: "luannh@gmail.com" Blood Type: "AB+"	Announcement "The same number of people have identity cards; This volunteer already exists in the system"

5. Conclusion

The application was built and tested on the data of blood donors living in Binh Thanh and Go Vap districts in Ho Chi Minh City, with data collected from the Red Cross Society of Binh Thanh District and students at the Industrial University of Ho Chi Minh City. Based on a 3-layer model architecture and using Entity Framework to interact with the database, the authors have developed a website to manage voluntary blood donations. The application meets basic functions such as managing blood donors, viewing blood donation history, managing blood stocks, creating blood donation schedules, managing user accounts, and searching for blood donors who meet the search conditions. When the system is implemented, it will support medical units in strictly managing blood donation volunteers. In addition, the application also supports hospitals and medical centers in finding volunteers who can donate blood to reduce the current blood shortage.

The author team's next work will connect more medical facilities to the system to manage more blood donors and have more databases to search for blood donors in school-emergency cases. The development direction of the project is to build an application on a mobile application platform to create more convenience for users and add online communication features between medical units and volunteers through images, chat online, or call directly.

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