

CS 9223 Cloud Computing: Project Report

ABO

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1. Project Overview

Blood is the most valuable gift you can give to someone, since it saves lives. However, we have noticed that there isn't an organized blood donation system to allow people to donate blood to those in need at a timely manner. Blood is always needed at hospitals, and rare blood types can be difficult to come by. However, given that blood can only be used within certain amount of time¹, we can't simply collect as much blood as possible, since that would cause unnecessary waste. Meanwhile, if a certain hospital or patient needs urgent blood donation, there isn't an effective way to communicate such needs to the potential blood donors within the current blood donation system.

Our goal for this project is to create a blood donation system that helps hospitals to quickly find the donor for their patients, which ensures fresh blood supply to patients, avoids potential blood waste, and allows donors to see immediate impact of their kindness.

¹ 42 days if you don't freeze it. <https://www.redcrossblood.org/learn-about-blood/what-happens-donated-blood>

2. Solution

Our ABO application will be the solution to the current lacking blood donation system.

Here are the basic functionalities of ABO:

- ABO will allow users to register either as a hospital or as a blood donor.
- ABO will allow hospitals to create a list of patients who need blood.
- ABO will allow hospital to send out requests for blood for a certain patient.
- ABO will allow blood donors to see a list of requests based on the blood donor's blood type and the patient's blood type, and based on their geo locations.
- ABO will allow blood donors to respond to a certain request
- ABO will allow the hospital to review a blood donor's response
- ABO will allow the hospital to accept or deny the response of the blood donor

Specifically, ABO will address the following issues of the existing blood donation system:

a. Blood is not collected at demand

The current blood donation system doesn't collect blood at demand, which could cause potential waste of blood. ABO ensures that a request for a certain type of blood is only sent out when there's an immediate need for it.

b. Blood is not collected at a timely manner

The current blood donation system doesn't have an established method to communicate certain urgent needs of blood. For emergency situations, blood would be needed in a short period of time. ABO enables hospitals to send out such urgent needs and hence allows urgent blood donations requests to be met.

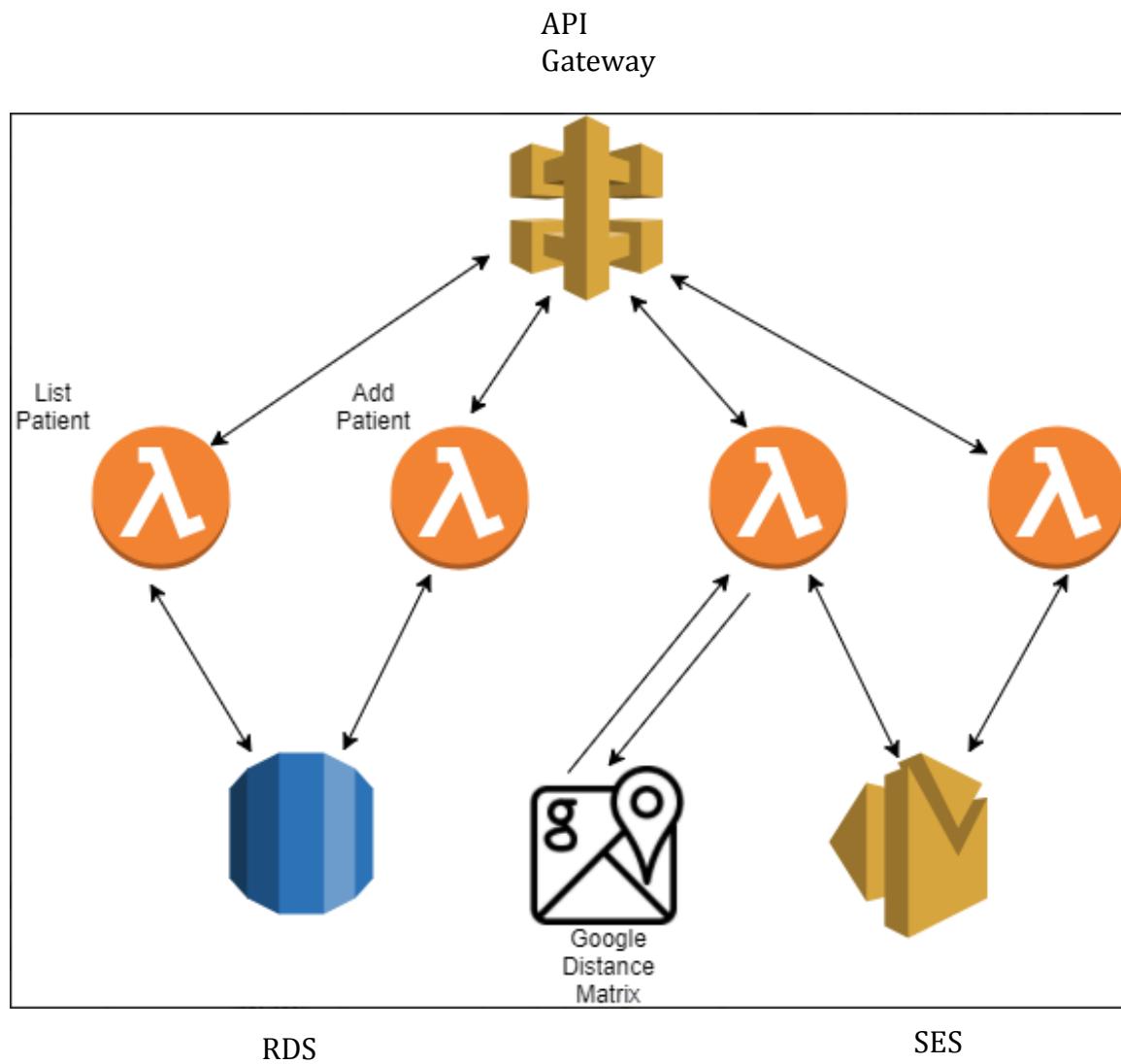
c. Potential blood donors are not reached

The current blood donation system doesn't have an effective way to reach potential donors. ABO is an iOS application, which allows potential blood donors to be reached anywhere as long as they have their phones.

d. Blood donors cannot see immediate impact

The current blood donation system doesn't allow donors to know how their blood may have been used. Allowing blood donors to actually see the impact of their donation could encourage them to do more donations in the future. ABO allows blood donors to actually know where their blood is used.

3. Architecture



4. Implementation

4.1 Overview

In this project, we have decided to use the following technologies:

AWS API Gateway – Works as a single point of communication with the front-end and the back-end

AWS Lambda Functions – Written in Python 2.7

AWS SES – for email notifications

RDS – MySQL Instance

Google Distance Matrix (python) – To calculate the distance between two points

4.2 Details

Initially, we planned to use the SQL Server as the database; however, the connector plugins available now for python is not ideal, so we decided to shift it to MySQL.

We are using AWS Lambda functions since it is not only convenient to use but also gives us the flexibility to focus on our actual application, instead of setting up and maintaining servers to meet our requirements, given that it could takes quite amount of time and energy. Writing the code for lambda functions does not take too much time, but it's the process of linking and integrating the whole application together that's time-consuming. Overall, AWS Lambda is easy to use and user friendly.

Furthermore, we used Google Distance Matrix since we need to calculate the geo locations between hospitals and donors. Google Distance Matrix is powerful and comprehensive, thus it is the first thing that comes to our minds.

As for algorithms, there is not a custom algorithm that we have used in our project. The core algorithm we implemented is to match donors with patients. We follow general blood donor and receiver rules where we take blood group and RH factor into consideration. For example, a patient with a blood type of A- can only receive blood from individuals who have a blood type of A- or O-. Hence if a hospital sends out a request on behalf of such a patient, only blood donors with a blood type of A- or O- will see the request.

Below is the complete list about how blood group matches between donors and receivers², and we have implemented it in one of the Lambda functions.

If your blood type is:	You can give to:	You can receive from:
O+	O+, A+, B+, AB+	O+, O-
A+	A+, AB+	A+, A-, O+, O-
B+	B+, AB+	B+, B-, O+, O-
AB+	AB+ Only	All blood types
O-	All blood types	O- only
A-	A-, A+, AB-, AB+	A-, O-
B-	B-, B+, AB-, AB+	B-, O-
AB-	AB-, AB+	AB-, A-, B-, O-

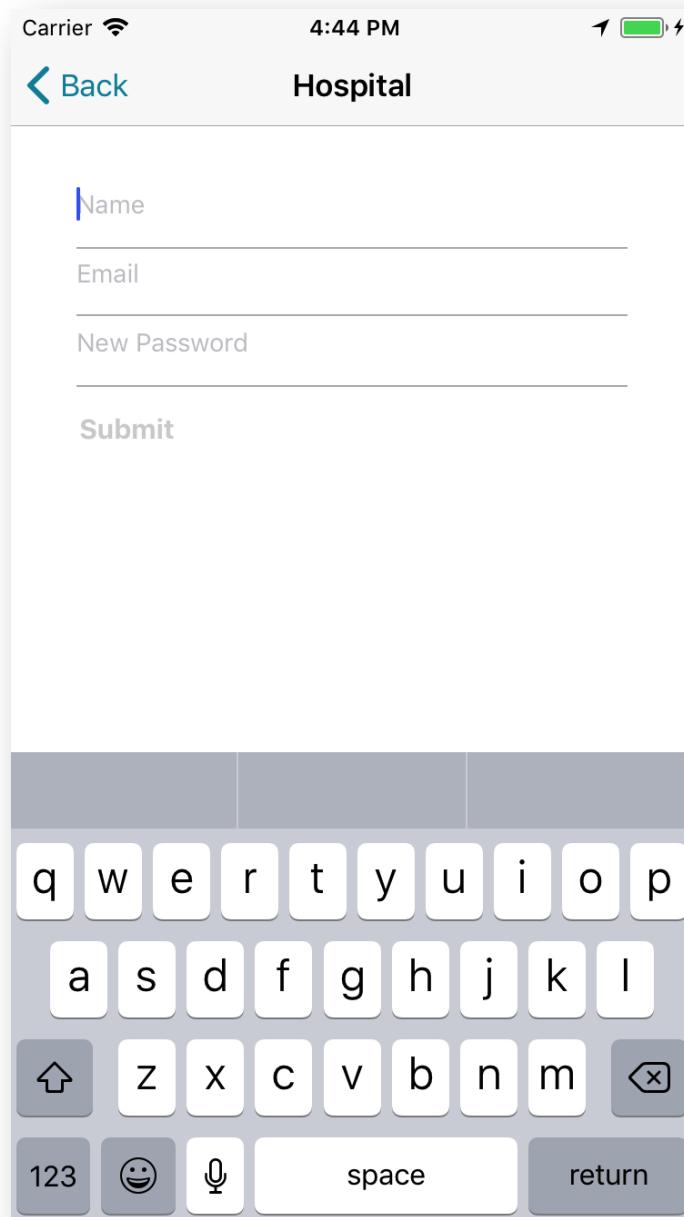
As regarding datasets, we haven't used publicly available data. At this stage, we just filled out SQL Tables with custom data so that we could test our application.

² <http://www.thebloodcenter.org/Donor/BloodFacts.aspx>

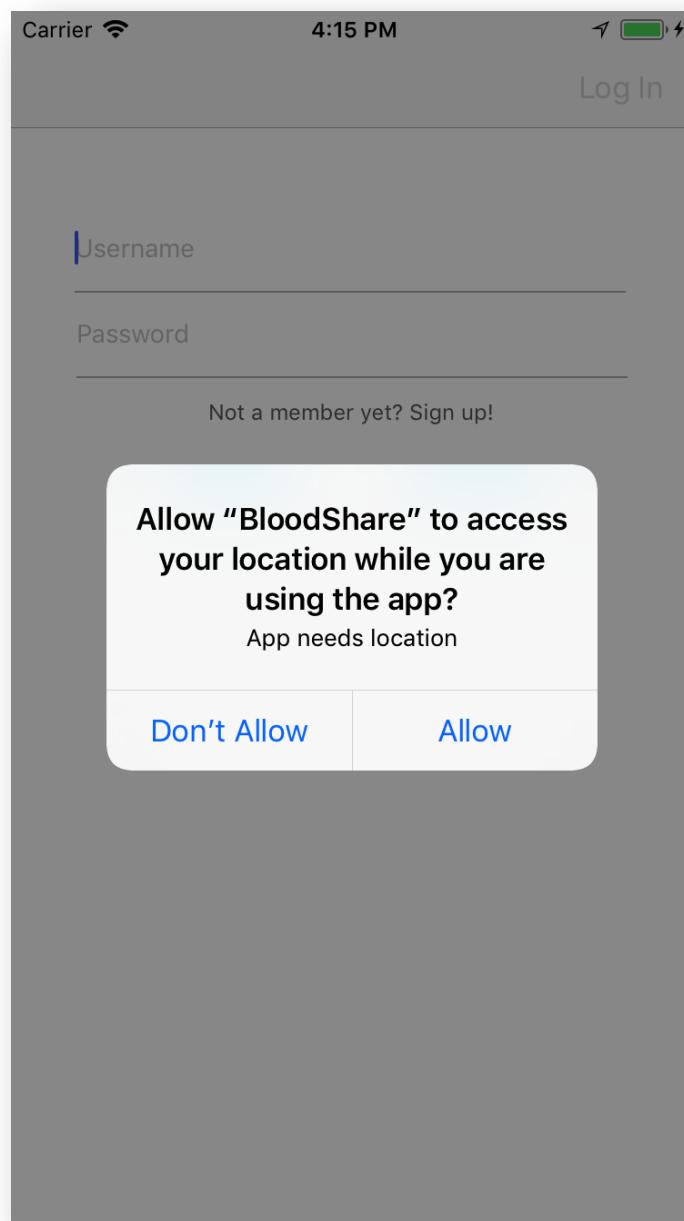
5. Results and User Interface

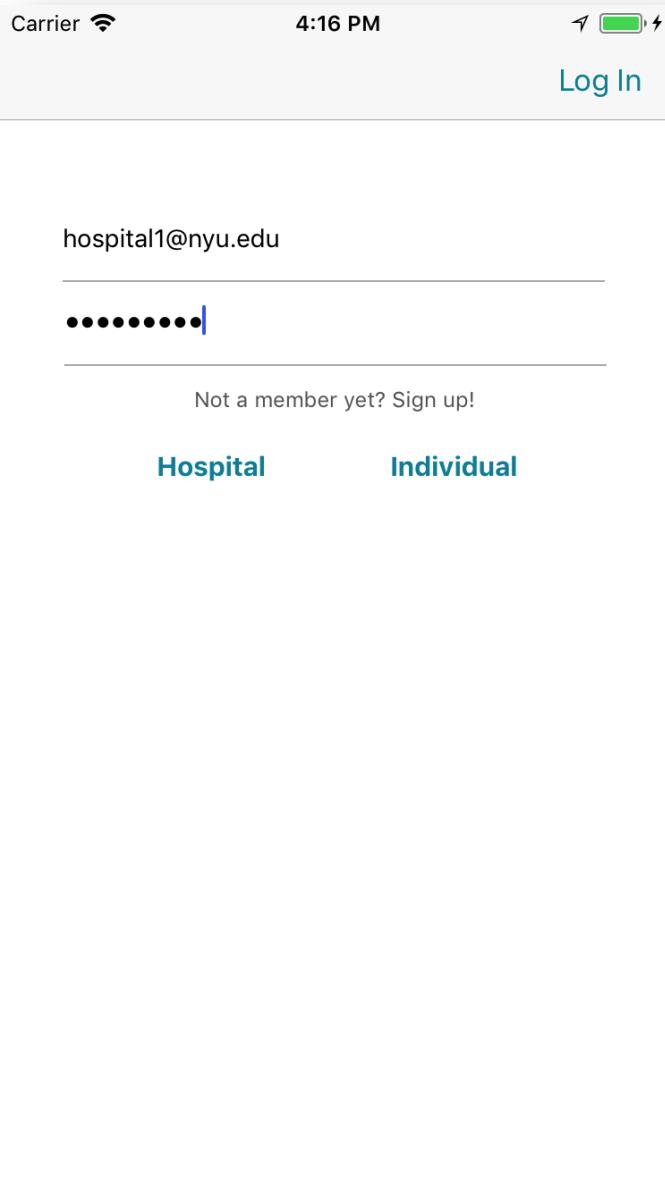
5.1 User Interface for the hospital side

- Sign up:

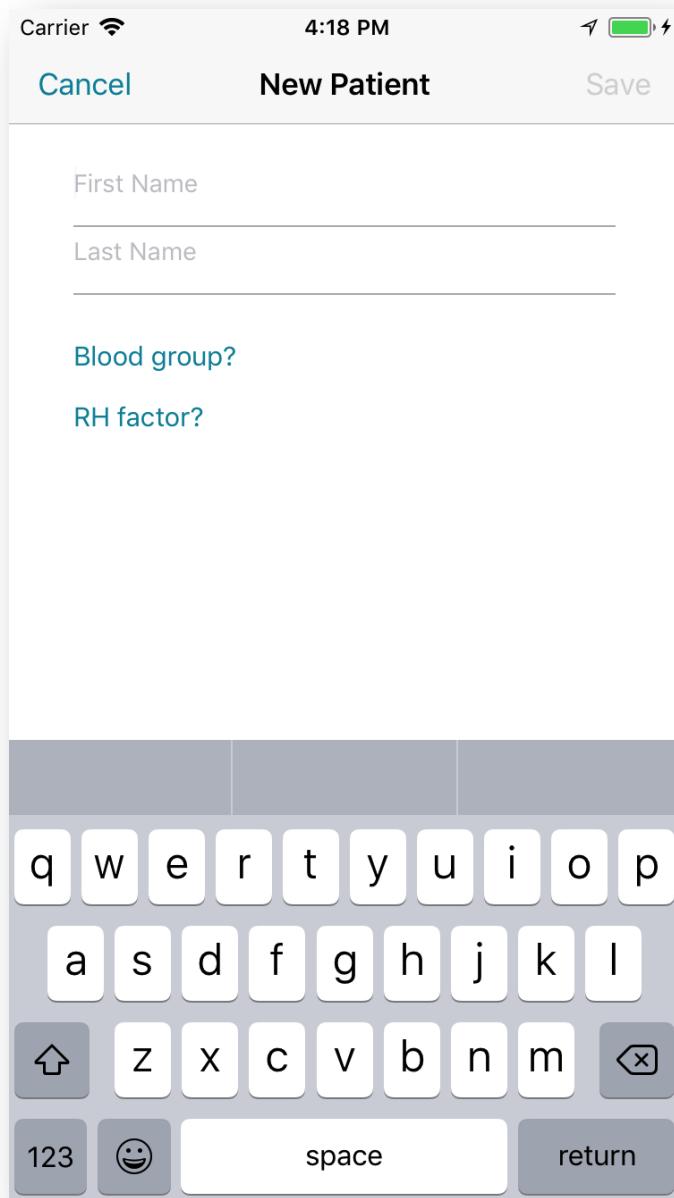


- Sign in

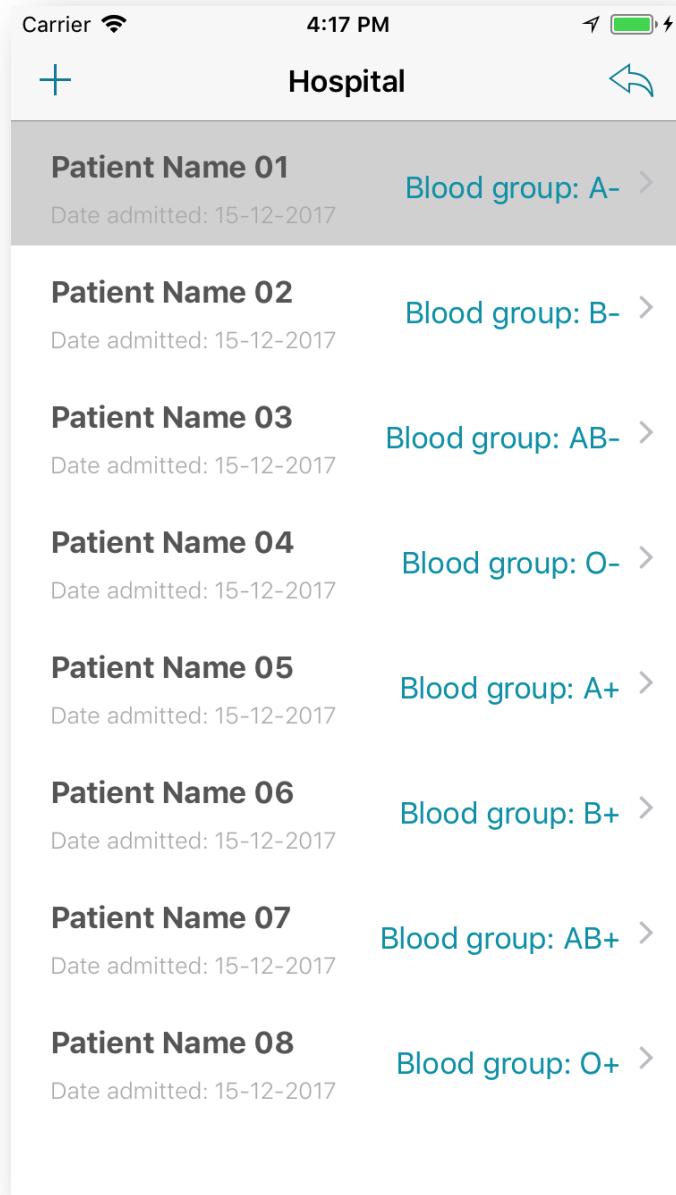




- Create a new patient:

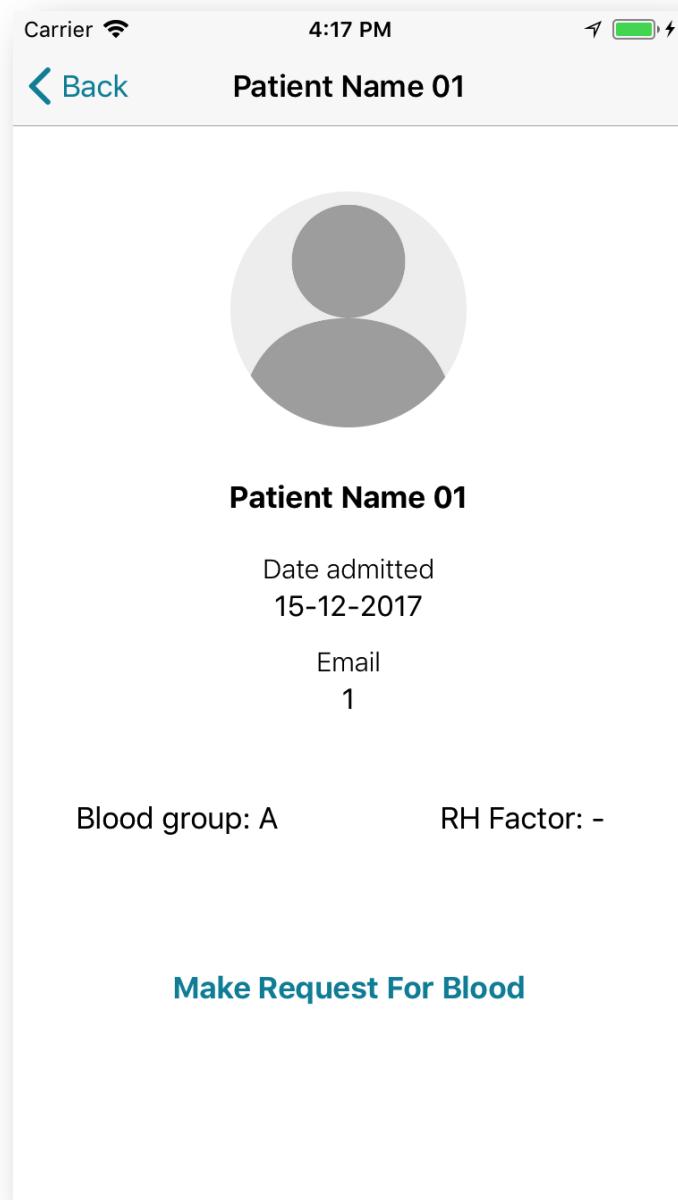


- List of patients:

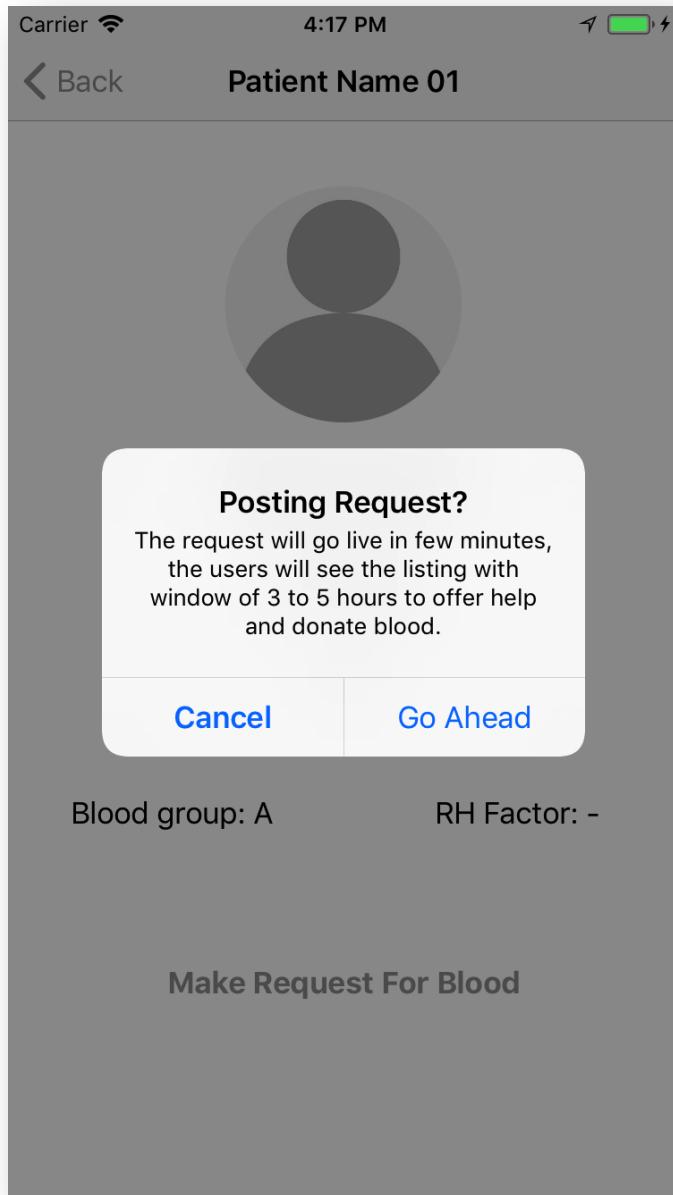


Carrier	4:17 PM	Battery
+	Hospital	◀
Patient Name 01	Blood group: A-	▶
Date admitted: 15-12-2017		
Patient Name 02	Blood group: B-	▶
Date admitted: 15-12-2017		
Patient Name 03	Blood group: AB-	▶
Date admitted: 15-12-2017		
Patient Name 04	Blood group: O-	▶
Date admitted: 15-12-2017		
Patient Name 05	Blood group: A+	▶
Date admitted: 15-12-2017		
Patient Name 06	Blood group: B+	▶
Date admitted: 15-12-2017		
Patient Name 07	Blood group: AB+	▶
Date admitted: 15-12-2017		
Patient Name 08	Blood group: O+	▶
Date admitted: 15-12-2017		

- Patient profile:

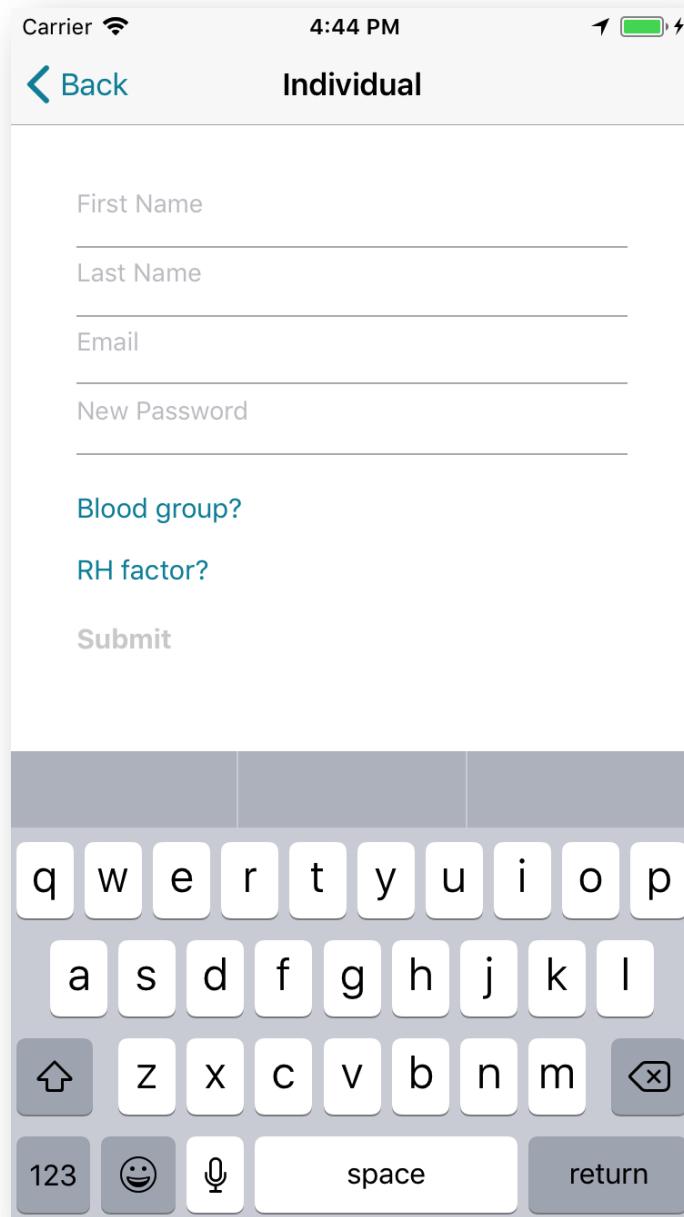


- Post a request:

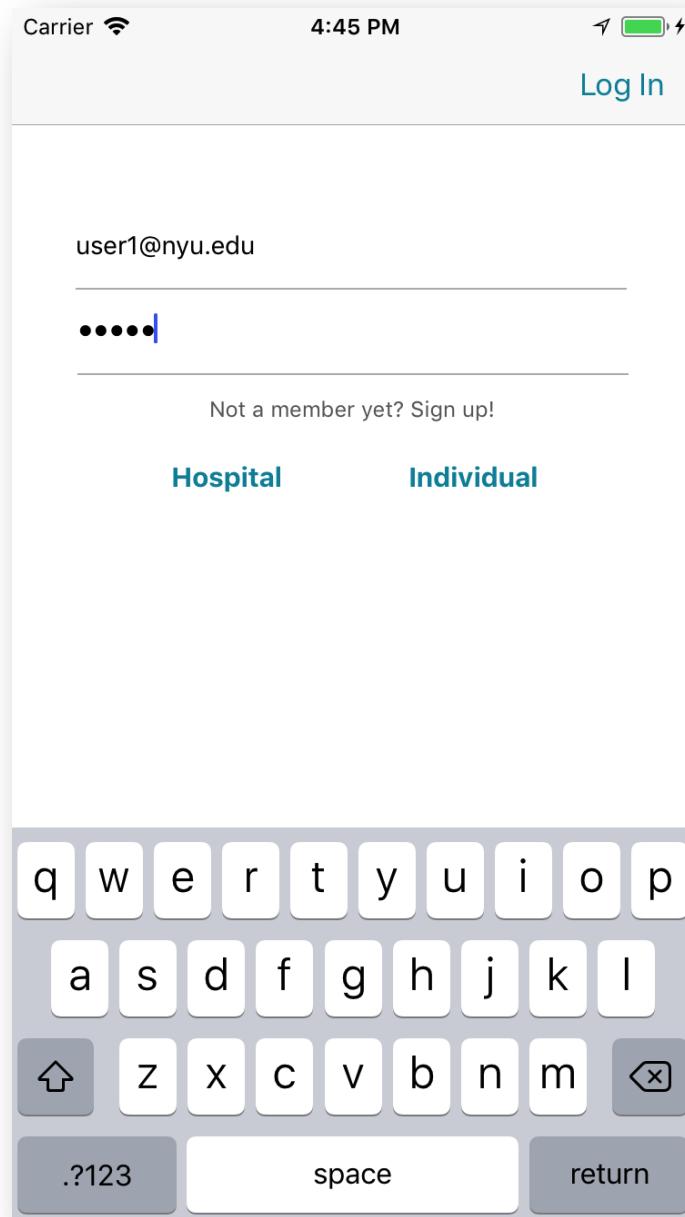


5.2 User Interface for the donor side

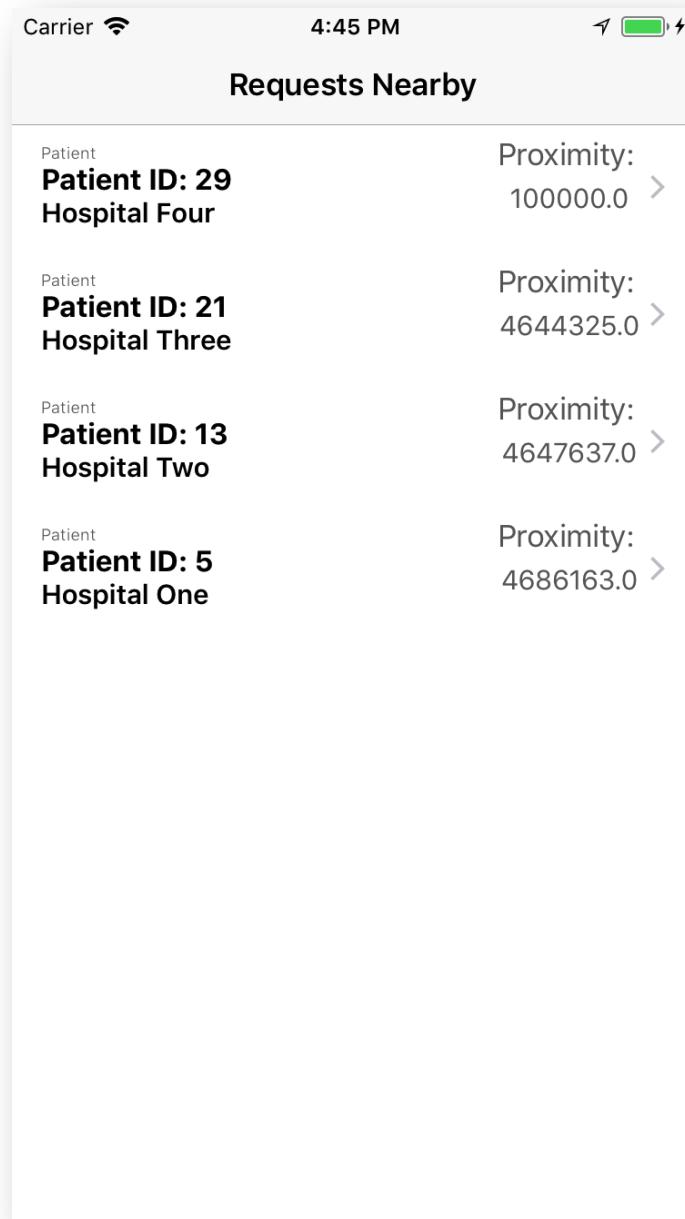
- Sign up



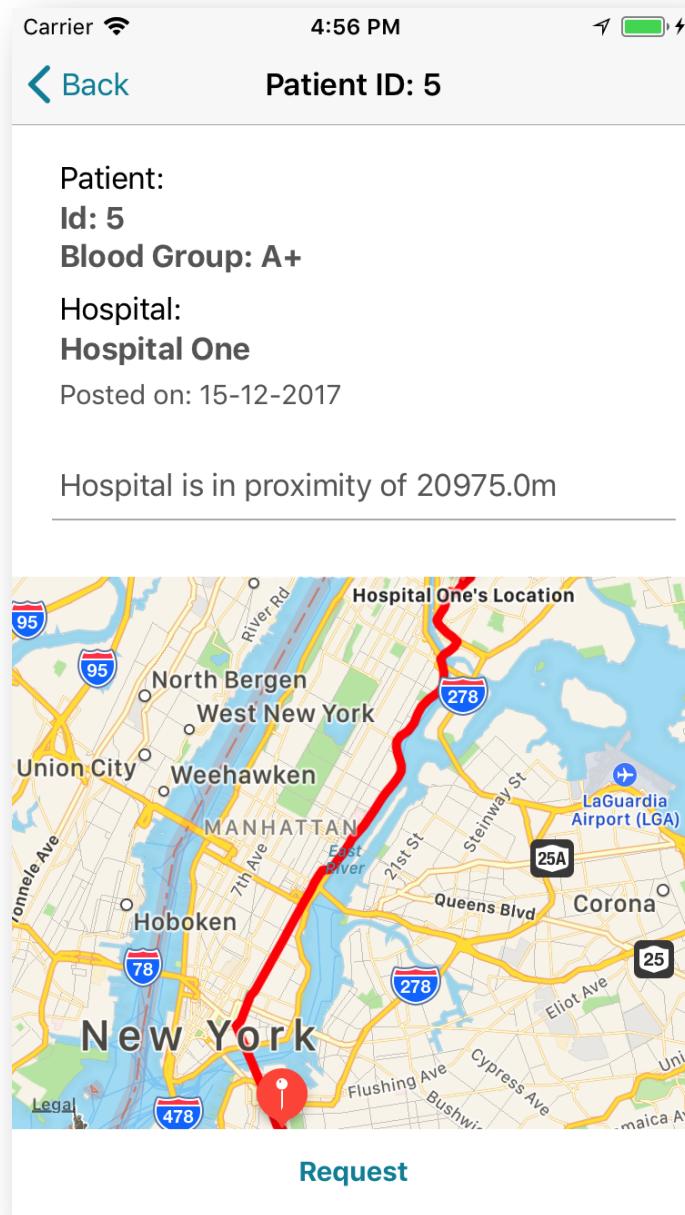
- Sign in



- See requests



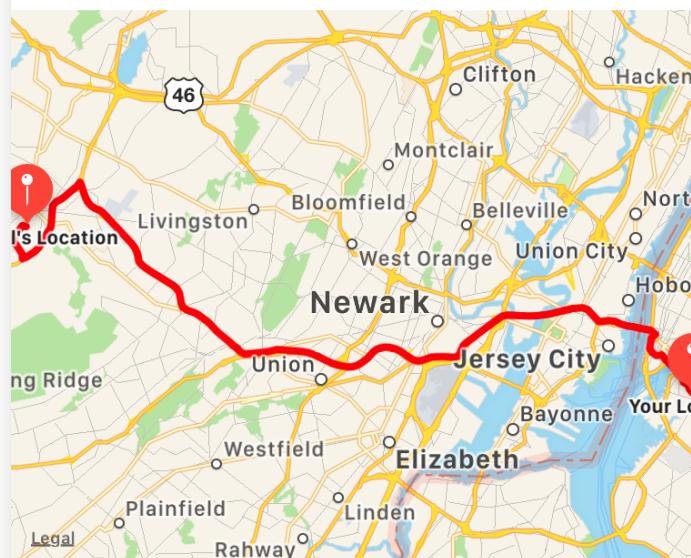
- See request:



[Back](#)**Patient ID: 13****Patient:****Id: 13****Blood Group: A+****Hospital:****Hospital Two**

Posted on: 15-12-2017

Hospital is in proximity of 62347.0m

**Request**

6. Summary

Overall, ABO achieved our goal to create a blood donation system that helps hospitals to quickly find the donor for their patients. Nevertheless, we see that this application could be improved in the following ways:

Currently, ABO blood donors all have their individual profiles created within the ABO system, and a request would show on the blood donor's home page based on the donor and patient's blood types, as well as the their locations. However, we noticed that people would be more willing to donate blood to someone they know rather than strangers. We could use this information to allow ABO to be connected with social media (i.e. Facebook), so that the requests list that the blood donors' see will give priorities to the patients who's the blood donor's friends, or friend's friend etc. Such change should motivate more blood donors to respond to a request.

Moreover, if we actually integrate social media into ABO, we would need better matching algorithms in terms of finding a suitable blood donor for a certain patient. Currently we are only considering their blood group, RH factors, locations, and we would like to also consider the connections between the donor and the patient in the future.

The current matching process of a patient and a blood donor still relies on manual actions to some degree (i.e. hospital still have to maintain their patients' list, and they still need to approve or deny a blood donor's request manually), and we can see the potential of automating this whole process, so that the hospital can easily maintain the patient list, and donors will only see relevant requests.

The current application is based on iOS platform, and we could expand it to other platforms such as web and android.

ABO is a blood donation system, and we could expand it scope to allow other type of donations such as organ donations.

7. Source Code

7.1 Github Link

<https://github.com/kushagraagarwal19/BloodBank>