

Slide 1

A presentation slide with a blue background. The title 'Team H2O' is in large white font. Below it, in smaller white font, is 'CS6440 - Introduction to Health Informatics - Fall 2017' and 'Team Final Presentation'. To the right is a large blue water drop icon. Below the title, the text 'Video URL: [YouTube](#)' is shown. At the bottom, a white box contains a list of team members and their email addresses. A small speaker icon is in the bottom right corner.

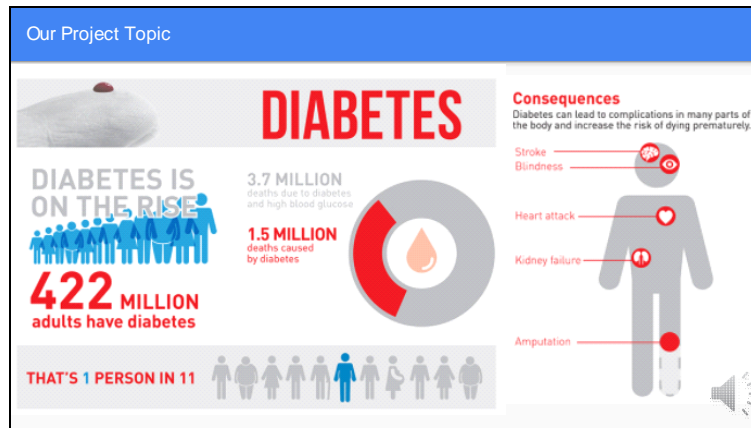
Team H2O

CS6440 - Introduction to Health Informatics - Fall 2017
Team Final Presentation

Video URL: [YouTube](#)

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Hello, we are team H2O and this is our Team Final Presentation.



Our project dealt with addressing how diabetics can better manage their condition. The inability to manage diabetes is a global phenomenon as seen in this World health organization infographic. 422 million adults have diabetes, 1 in eleven people. In the United States alone, it is the 7th highest rank among causes of death. The failure to manage the condition can lead to serious health conditions on almost every part of the body.

Monitoring blood sugar levels is the main health data every diabetic patient has to keep track and healthy meals is considered a major factor to keep diabetes in check but oftentimes people will not keep track of what they are eating or even intentionally not take meals. Tracking one's diet can be done through mobile apps, making for a quick and easy way to try to manage the condition. That is the original objective our team sought to build out a solution for.

Diabetes and Health Tracking. (n.d.). Retrieved October 07, 2017, from <http://www.mynetdiary.com/diabetes.html>

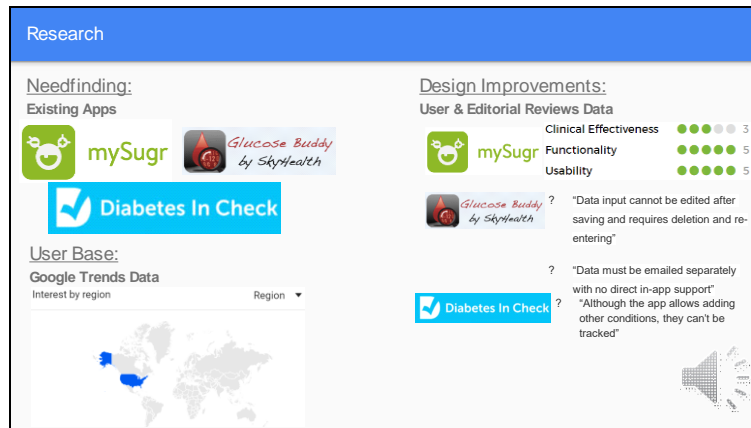
Diabetes diet: Create your healthy-eating plan. (2017, March 25). Retrieved October 07, 2017, from <http://www.mayoclinic.org/diseases-conditions/diabetes/in-depth/diabetes-diet/art-20044295?pg=2>

How Does Diabetes Affect Your Body? (n.d.). Retrieved October 07, 2017, from <https://www.webmd.com/diabetes/guide/risks-complications-uncontrolled-diabetes#1>

Petrow, S. (2015, June 15). The app revolution for diabetics. Retrieved October 07, 2017, from https://www.washingtonpost.com/national/health-science/the-app-revolution-for-diabetics/2015/06/15/6810d13a-0481-11e5-8bda-c7b4e9a8f7ac_story.html?utm_term=.71d1200935e3

Weisenberger, J. (2014). The Dangers of Skipping Meals When You Have Diabetes. Retrieved October 07, 2017, from <http://www.diabeticlivingonline.com/food-to-eat/nutrition/dangers-skipping-meals-when-you-have-diabetes>

World Health Organization (2016)[Global Report on Diabetes] [Infographic]. Retrieved from <http://www.who.int/campaigns/world-health-day/2016/en/>



Initially, we looked at dieting apps and speculated on whether a similar app could be produced for other healthcare purposes. After all, from the lectures we know that much of the healthcare costs in the U.S. stem from treating chronic illnesses, many of which are caused by obesity and diet problems. To determine this need, we looked at existing applications that help diabetics lower their glucose level by logging food.

The app, mySugr, is especially popular with over 1M users and was even bought for over \$100M by Roche. [1] Next, we needed to expand on current application features and determine additional user needs and use cases.

The result seemed to say that while the UI was great, it didn't tie in well with the healthcare industry. Integration with HL7 FHIR could increase this "clinical effectiveness" and allow users to have glucose levels and other electronic health record information pulled in automatically without having to re-enter and re-log glucose test data.

Need for Nutritional Health Apps:

- [FDA Stance on medical apps] (<https://www.fda.gov/MedicalDevices/DigitalHealth/MobileMedicalApplications/default.htm>)
- [Diabetes and its drivers] (<https://clindiabetesendo.biomedcentral.com/track/pdf/10.1186/s40842-016-0039-3?site=clindiabetesendo.biomedcentral.com>)

Healthcare Apps for Diabetics:

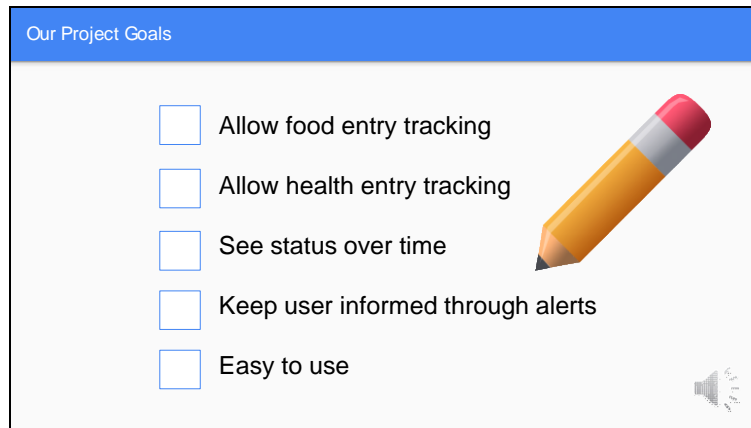
- [mySugr] (<https://mysugr.com/>)
- [Glucose Buddy] (<http://www.glucosebuddy.com/>)
- [Diabetes in Check] (<http://www.diabetesincontrol.com/diabetes-in-check/>)

Healthcare App Reviews:

- [TechCrunch - mySugr acquisition] (<https://techcrunch.com/2017/07/07/diabetes-platform-mysugr-exits-to-roche-for-as-much-as-100m>)

- [RankedHealth - mySugr review] (<http://www.rankedhealth.com/review/mysugr/>)
- [RankedHealth - Glucose Buddy review] (<http://www.rankedhealth.com/review/glucose-buddy/>)
- [iMedicalApps - Glucose Buddy review] (<https://www.imedicalapps.com/2012/07/glucose-buddy-app-diabetes-patients-clinicians/>)
- [Steady Health - Diabetes in Check review] (<https://www.steadyhealth.com/review/diabetes-in-check-app-blood-sugar-carbs-and-medication-tracker-with-tons-of-healthy-recipes>)

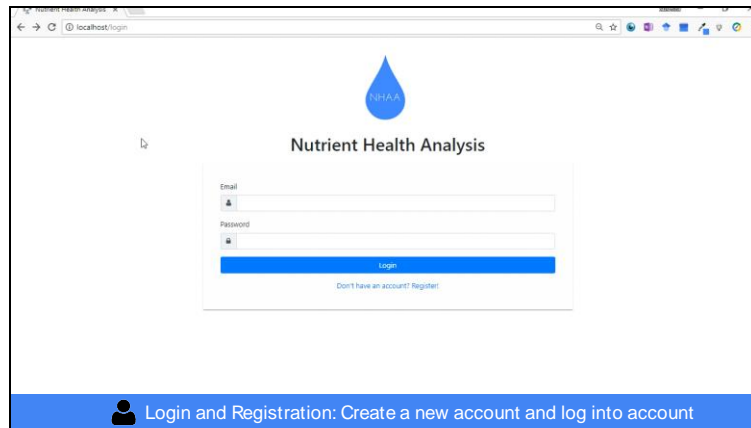
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Our team identified that our application should target the following objectives:

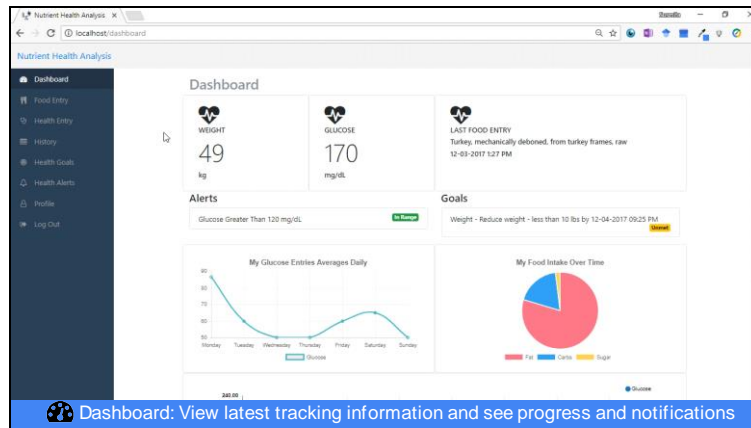
- It should allow for food entry tracking - it should be able to pull from an existing food database that would have a wide variety of foods for the user to pick from
- It should allow for health entry tracking - it should provide the ability to enter in health values for the user to keep track of glucose measurements
- It should allow for the user to monitor their health and check their health status over time
- It should alert the user to changes to their health so that they can be informed
- It should be easy to use this application at any time of day

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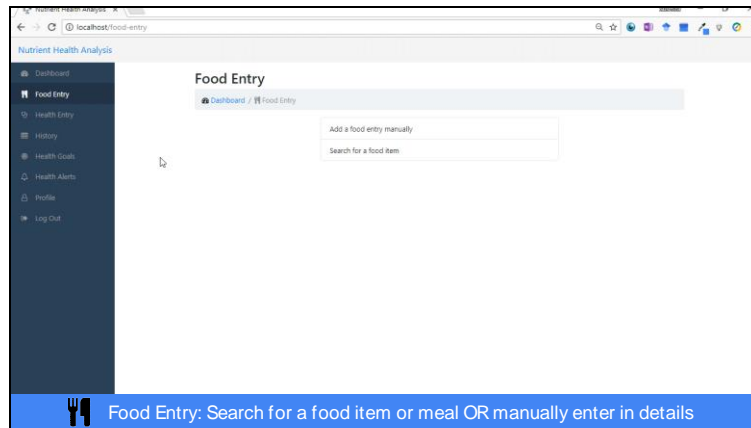
We begin the demo with the application login screen. As a new user, you will go to the register screen and create a new account. You will enter in a first name, then last name, and a valid email address. The application validates all of the fields. For example, here the application alerts us about the password and once it is changed you will be able to successfully register. Now, you will be able to login with your credentials. Now that you are logged in and reaching the landing page, the dashboard screen you are ready to start using NHAA.

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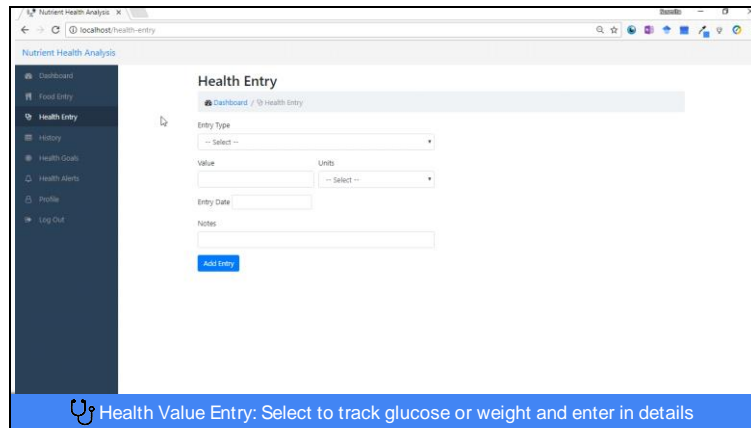
Upon login, you will be presented with the dashboard view, which shows the latest food and health tracking information and presents metrics to show your progress. At the top are the average weight and glucose measurement values and the last food entry. Next, you will see alerts and goals for your account. Then there are graphs showing the glucose daily averages, food entries' averages for fats, carbohydrates, and sugar. Finally, there is a graph that shows each of the glucose values you have entered in the past seven days to see what kinds of trend exists.

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This screen is the food intake entry. You can either choose to add a food entry manually and enter in nutrients information or search for a food item and populate the nutrients data from the usda database. To search for a food item, click on search and enter in the name of a food item or meal such as "Turkey" and see that the search returns a list of foods. This is data coming back from the USDA database. Next, select the food item that you wish to save and see that the screen now gets populated with the nutrient values for Turkey. Next, add in a serving size, consumption date and time, and you have the option to enter in a note to easily reference this food entry later. Save this entry and see a confirmation message it got saved. Similarly, if you were to enter a custom food item, you could select "Add our own item", enter in the name of the food, the nutrient details that you wish to save, and the same other fields as before, servings, consumption date/time, note and save this custom food item for your tracking.

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The screenshot shows a web application titled "Nutrient Health Analysis" with a sidebar menu containing "Dashboard", "Food Entry", "Health Entry", "History", "Health Goals", "Health Alerts", "Profile", and "Log Out". The "Health Entry" page is active, displaying a form with the following fields: "Entry Type" (a dropdown menu), "Value" (a text input), "Units" (a dropdown menu), "Entry Date" (a date input), and "Notes" (a text area). A blue "Add Entry" button is located at the bottom of the form. Below the form, a blue banner contains the text: "Health Value Entry: Select to track glucose or weight and enter in details".

This is the health value entry screen. You can select a measurement type and enter in the value and other details for their entry. First, select the entry type, picking glucose. Then enter in a value such as the latest glucose measurement from a glucometer. You can enter in 70, pick the unit, enter in an entry date and time, and for notes enter in measurement before breakfast. This entry has now been saved. You can also add a weight health entry by populating values for the same fields, for example if your weight was 120 lbs you could add in 120 lbs, the entry date, and a note and save it.

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History

Dashboard / History

Global Filter

My Food History

Date	Name
11-27-2017 9:25 PM	ESSENTIAL EVERYDAY CHUNKY SOUP GUMBO, GRILLED CHICKEN & SAUSAGE, MADE WITH LEAN CHICKEN MEAT, UPC: 041303017067
12-03-2017 9:09 PM	Turkey, mechanically deboned, from turkey frames, raw
12-03-2017 1:27 PM	Turkey, mechanically deboned, from turkey frames, raw

Global Filter

My Health History

Date	Type	Value	Units	Notes
11-26-2017 9:28 AM	Glucose	90	mg/dL	
11-26-2017 9:32 AM	Glucose	180	mg/dL	
11-26-2017 9:35 AM	Glucose	100	mg/dL	
11-27-2017 9:20 AM	Glucose	120	mg/dL	Starting glucose
11-27-2017 9:19 PM	Weight	49.94	kg	Starting weight

History: View all entered food and health value entries

So now that you've created food and health entries in their respective screens, you can view those and also any previously created entries in the history screen. On the top table, you can see all of the food entries, use the filter to find a particular entry, and also see the details for that entry. Similarly, you can check the bottom table for all of your health entries and their details.

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Nutrient Health Analysis

Health Goals

Dashboard / @ Health Goals

Add a Goal

Goal Name

Goal Entry Type

Value Units

Goal Range Type

Goal Time Period

Goal Target Date

Save Goal

Goals

Weight - Reduce weight - less than 10 lbs by 12-04-2017 09:25 PM

Health Goals: Select a goal type, enter in details, view status

The next screen we are showing you is the health goals screen. Here, you can create your own personal health goals that you want to target achieving within a certain time period through the help of this application. So for example, perhaps you have been tracking your fasting glucose levels daily and now you have a goal to keep your glucose measurement levels to 80 mg/dl. You can select glucose for the goal entry type, enter in 80 and pick milligrams per deciliter as the unit, select greater than as the goal range type and instant so that the goal gets calculated from values right away and I select a target date/time to be december 10th as you want to see if you can reach this goal within one week. Once you save the goal, the application will assign a status to it either met or unmet and the status will change as your values get inputted. For instance, let's check out a previous goal that was added with a deadline of today. The application lets you know that this was a goal you achieved vs. this one that you did not and allows you to try again.

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Nutrient Health Analysis

Health Alerts

Dashboard / Health Alerts

Add an Alert

Entry Type:

Value: Units:

Alert Range Type:

Alert Time Period:

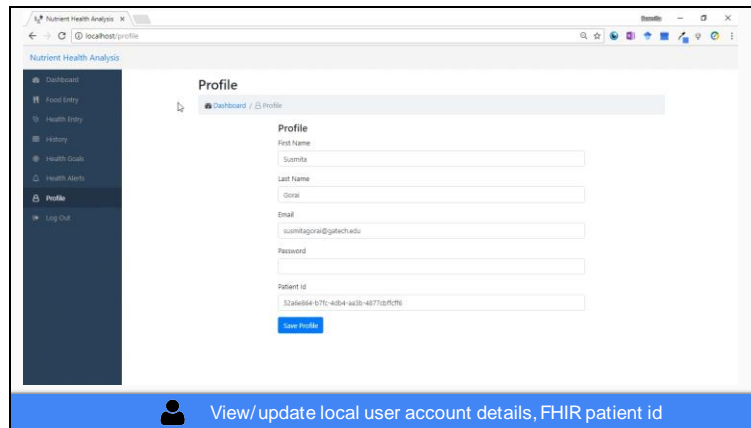
Alerts

Glucose Greater Than 120 mg/dL

Health Alerts: Select a health metric and enter in a particular value and range

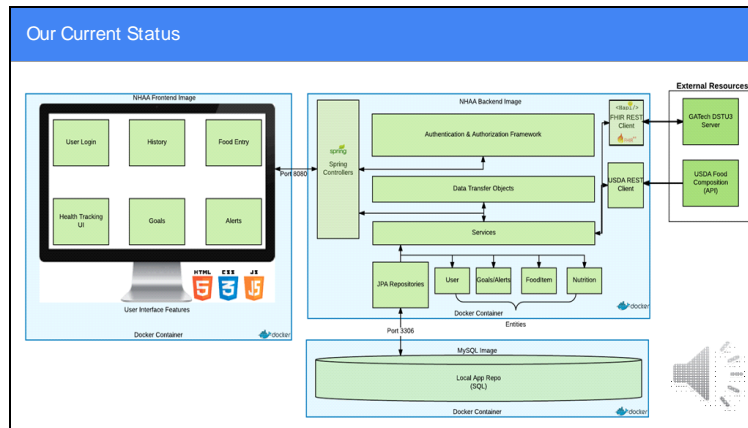
We are now in the health alerts screen where you can create alerts to monitor our health and allow the application to inform you of any changes to your health that you want to be aware of. So select to add an alert to track how much sugar you are consuming. So select sugar, put in 20 grams, and greater than for the alert range type, and lastly select “last 24 hours” for the alert time period. So as you input in foods and their sugar content is recorded in the application, you would be alerted if your daily sugar intake exceeds 20 g. Remember to click on save to set this alert and now see the status “ “ to see . The alerts are also available in the dashboard so you could see them quickly there as well.

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The screenshot shows a web application titled "Nutrient Health Analysis" with a browser address bar at "localhost/profile". A dark sidebar on the left contains navigation links: Dashboard, Food Entry, Health Entry, History, Health Goals, Health Alerts, Profile (highlighted), and Log Out. The main content area is titled "Profile" and includes a breadcrumb "Dashboard / Profile". Below this is a "Profile" section with input fields for First Name (containing "Sumita"), Last Name (containing "Gora"), Email (containing "sumitagora@gatech.edu"), Password, and Patient id (containing "37654-6564-aa3b-4b7716f4f6"). A blue "Save Profile" button is positioned below the Patient id field. At the bottom of the page, a blue banner features a user icon and the text "View/update local user account details, FHIR patient id".

The last screen we are going to show is the profile screen. Here you see your current account details which you can edit and update including your name, email address, and password. Also, there is a field called patient id that will show the generated patient id that is saved to the GT DSTU fhir server. You can also change the patient id to a pre-existing one to link your NHAA account to a different patient id and both retrieve and save data using that.

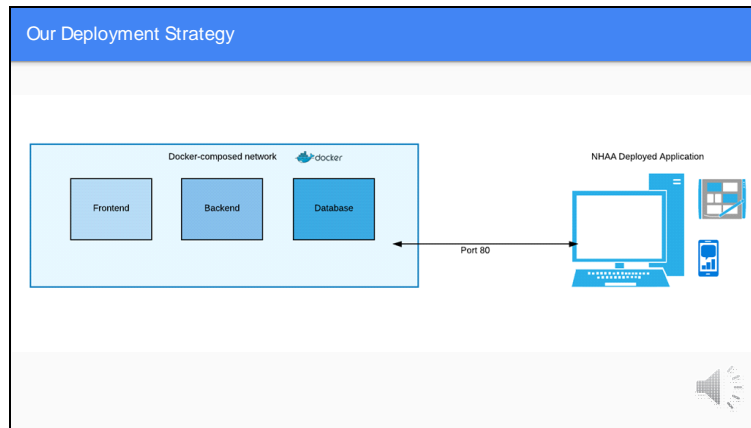


This diagram represents our final system architecture. From right to left, starting with the backend system design, we're using REST clients to connect with the USDA food composition repository for nutritional information and the Georgia Tech DSTU3 server via HAPI FHIR. FHIR information is not stored in any local repositories, the app pulls from the GATEch server, performs any needed calculations and comparisons and presents that information to the user. Any information the user enters is only saved on the GATEch server, not locally.

For user information, food tracking, and goals or alerts persistence, we used an object-relational mapping with JPA repositories. Information is stored in an SQL relational database and can be pulled and used by service classes that act as an interface between the Spring controllers and the repository objects. Data transfer objects are used to store temporary states associated with some of the entities, such as goals and alerts.

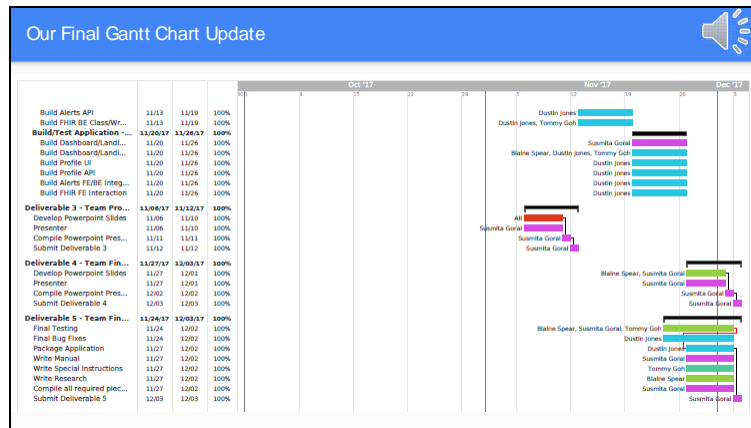
On the frontend, we have webpage interfaces built with Angular, Bootstrap, PrimeNG that can push and pull information to the backend through Spring controllers using POSTs, GETs, and DELETEs.

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For our deployment strategy, we have stated in our special instructions manual full details about our deployment process. Essentially, we will use the docker-compose command to build the three containers into a final compiled application which can be accessible from the browser from localhost port 80. The application will look for a mysql container on port 3306. Those two ports will need to remain open.

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This week was our final week completing the project. We focused on revisiting our plan on how best to complete our final project deliverables and decided we would each pick an area to focus upon before reviewing them together as a team to finalize them before submission. Dustin focused on the final application development, working to finish up the alerts and goals, bug fixes, and UI improvements. Tommy worked on the special instructions document and testing of the application. Blaine worked on the research document, testing, and final architecture diagram. I worked on the manual, final presentation, and testing. We worked with Dan to verify our Docker build works in his deployed environment before our final submission.

Did we meet our goals?

☐

Allow food entry tracking

☐

Allow health entry tracking

☐



See status over time

☐

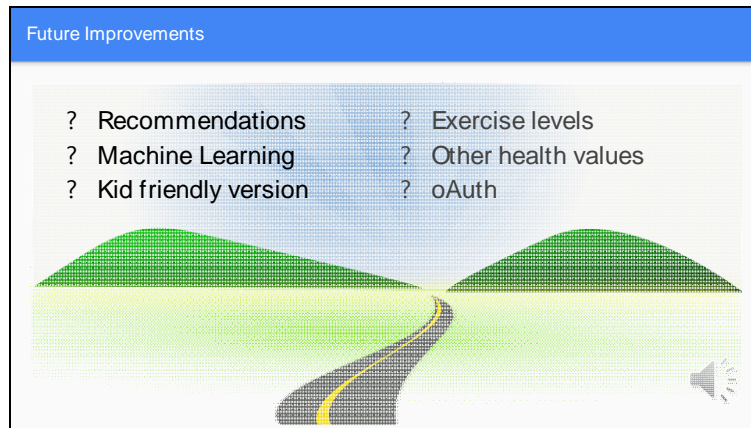
Keep user informed through alerts

☐





Easy to use



Previously, we shared that our team had identified these goals as our project goals. As a team, we believe we were able to develop an application that addressed all of these goals. The application allows for food entry tracking not only by searching from an existing USDA database but also allows the user to store their own custom food data. This allows a user to track a much wider variety of foods such as international foods. The application allows for health entry tracking for not only glucose levels but also weight values. The application allows the user to see their health status through multiple ways: goals in which they can set personal health goals they wish to meet and see the status of reaching them, history screen where they can see all of their entered data, and a dashboard screen with several metrics that are updated as the users' data gets inputted into the application. Also, data that was previously stored in FHIR is pulled into the application and also saved externally for use in other external systems through the patient id. The user can setup alerts for a variety of food or health value metrics. Finally, each screen's features are intuitive and easy to follow.



For future improvements of the application, a recommendations engine could be included that uses machine learning to interpret the users' entries and provide suggestions to the user to better maintain their health. The application design could be altered to produce a more kid-friendlier version to target users with juvenile diabetes. The application could also track other health factors that could influence their condition such as the amount of exercise. Finally, oAuth could be included to expand the storage and retrieval of the user data to external services.

Our Team Contributions			
 Susmita	 Dustin	 Blaine	 Tommy
? PM	? FE Dev	? BE Dev	? BE Dev
? FE Dev	? BE Dev	? Research	? Test
? Test	? PM	? Test	? Docker

Our team members all served in multiple roles throughout the duration of the project. We all had a “will work on anything” attitude that meant it was really easy for each of us to work on pretty much any task that needed to get done. For specific role contributions, I was the main PM, worked on frontend development, and testing. Dustin worked on both frontend and backend development and also was a PM. Blaine worked on backend development, research, and testing. Tommy worked on backend development, testing, and helping us with Docker.