

Health Monitor Application

Description of the application

Nowadays, people are paying more attention to personal health and diet. As a representation of body health, there are a set of well-defined health indicators such as Body Mass Index(BMI) and Waist-hip ratio(WHR) that people can calculate themselves for self-monitoring purposes. However, when it comes to real operations, people may find it difficult to keep track of their health situations using these indicators for a long time span without an easy-to-use application. In motivation to that, we developed an application that would record the user's health status across time and provide you feedback with useful diet and workout suggestions based on your input data. All you have to do is to provide some data about your body to our system and click a few buttons and then a detailed health report with various tips will be presented to you. Besides, you are able to see how your health situation develops through time from three charts with our application. With this cool application, keeping track of personal health becomes much easier.

How to use the application

This application has already been deployed on AWS Lambda and become serverless. So you can use this public URL (<https://fft3urm205.execute-api.us-east-1.amazonaws.com/dev>) to reach the login page of this application. If you want to update the lambda function, you could access Shixiong's AWS student's account and write the newest aws configure to your environment and connect to that account. Then follow these steps listed as follows to engage with this application:

1. Create account: Click the 'Create your Account' button and then you will be led to a page for registration. Enter a username and your email address, and then set your password for login. Note that if your username conflicts with any existing username in our database, the system will inform you to use a new username. So try to use a unique username. This also applies with the email address that you enter.
2. Login: After you create your account, you will be redirected to the login page. Use your registered email and password to log into the application.
3. Configure your data: After you log in, you will see the main page of this application. You will notice that there is no data in the history table, nor in the weight/BMI/WHR charts. This is because you haven't input any user data to our system. Click the 'Configure User Data' button on the left side of the top bar, then you will be led to the page for importing data. In the first session, you are required to provide your age, gender, weight, height, waist circumference, hip circumference and heart rate. Don't leave any field blank, since these are the most basic health measurements that you can easily get by yourself; also please provide integers following the hint message in those fields. In the second

session, i.e., the optional input session, you are asked to provide the upper (systolic) value of blood pressure, daily average steps, daily average sleeping hours, daily water drinking volume and daily vegetable eaten (in comparison with the total amount of food you eat during the day). These data are not that easy to get, that's why we do not require you to provide them. After you finish, click the 'SUBMIT' button.

4. View health report: After you submit your data, a health report will be generated automatically and presented to you. As you can see, an evaluation of your body shape is presented at the top of the report based on the weight and height value you provided. Some suggestions about how to make your body shape look better is shown, including diet and workout tips. Similarly, evaluations on your sleeping and eating situation based on your inputs will also be presented. Finally, you will see our carefully prepared meal plan for you.
5. View historical data: On the main page of the system, you can view a table which contains the past 10 times that you input your data, including the heart rate, blood pressure and daily steps that you provide, and some health indicators such as BMI, WHR (Waist Hip Ratio) and daily Calorie consumption that our application computes for you. To make it easier for you to visualize how your health situation evolves through time, we present three charts for you, which are Weight vs Time chart, BMI vs Time chart and WHR vs Time chart.
6. Account update and password recovery: You can always change your password after you log into our system. Just by clicking the 'Change Passwords' button on the right of the top bar on the main page, then you will be led to a page that requires you to enter your old password and enter your new password two times, then your new password is set. If you forget your username or password, go to the login page and click 'Forgot Username / Password?', and then enter your registered email address in the blank that is provided to you, then check your email inbox, a new password (a random string with the length of 8 characters) should be sent to you. Use this new password to login again, after log in, do not forget to change your password based on your preference.

Application architecture

Main functionalities

All the main functions of our application can be seen from the main page of our system, as shown in Figure 1, and the health report page after the user input the data, as shown in Figure 2. Note that there should be two additional charts other than the chart shown in Figure 1 below due to the screenshot restriction. The following is a description of our application's main functions in detail.

- Health indicator calculation: Our application can do basic health indicators (BMI, WHR and calorie consumption) calculation for users as you can see on the table of Figure 1. Please check the Appendix for detailed calculation of these indicators.
- Historical statistics: One cool thing about our application is that it can visualize the user data in a fancy way, that is, configuring a few charts for users to better keep track of their health development as you can see in Figure 1. All the users' weight, BMI, WHR

historical data points will be put on these charts to help them monitor their health situation.

- Health evaluation and suggestions: Our application can also provide health evaluation and suggestions based on the user's input data. These evaluations and suggestions are summarized in an organized way and our application can automatically generate a report to the users after they input their corresponding data. As shown in Figure 2, the evaluation includes the body shape analysis, sleeping situation analysis and dietary habit analysis, and the system will also provide all kinds of meal plans to different users in various health states based on our evaluation.

Hello Qixuan

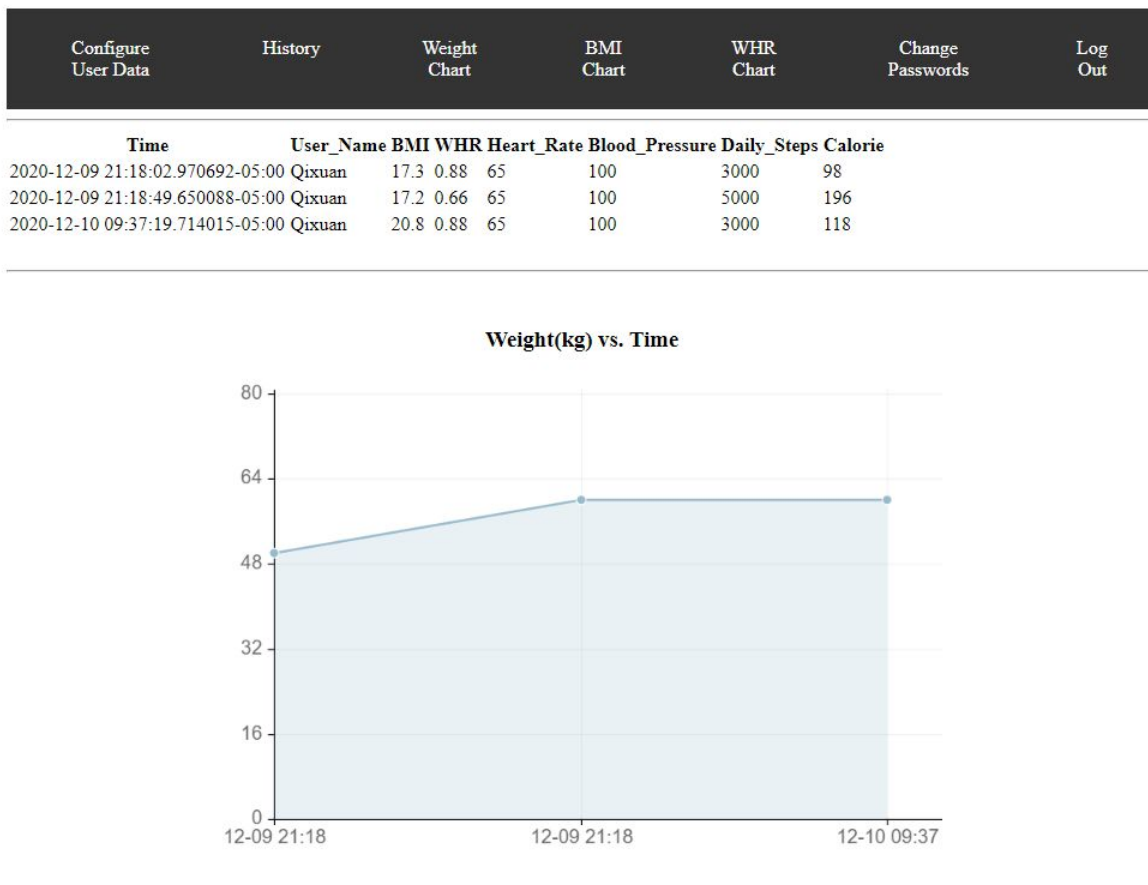


Figure 1: Main page of the application

Response for qixuan.zhang@mail.utoronto.ca

[Back to Home Page](#)

BMI result: Obesity

- Risk: To causes a large number of health conditions, including heart disease, stroke, diabetes, high blood pressure, unhealthy cholesterol, asthma, sleep apnea, gallstones, kidney stones, infertility, and as many as 11 types of cancers, including leukemia, breast, and colon cancer.
- Consume less fat, Eating more vegetables and fruits help keep calories reasonable and reduce the risk of overeating.
- Regular weight training, find a professional trainer to design training plans, including strength training, and some cardio workouts such as walking, jogging, running, cycling, or swimming.
- Try to reduce daily stress, stress may trigger a brain response that changes eating patterns and leads to cravings for high-calorie foods.
- Set weight goals and find someone could support you and encourage you.
- Weight-loss medications, a doctor will sometimes prescribe medication, such as orlistat (Xenical) to help a person lose weight.

Your sleeping is current in a good condition.

--Drinking too much water:

- As you intake more water you can begin to flush water soluble vitamins and minerals.

--Your dietary habit is good, and please remember to keep half of your plate at any given meal—about 30 percent vegetables and 20 percent fruit.

Meal Plan for you:

Breakfast — Omelet

- 2 eggs
- 1 ounce (28 grams) of cheddar cheese
- 1 cup (20 grams) of spinach cooked in 1 tablespoon (15 ml) of coconut oil
- 1 cup (205 grams) of sautéed sweet potatoes

Lunch — On-the-go Chipotle

- 1 Chipotle burrito bowl made with romaine lettuce, Barbacoa chicken, brown rice, 1/2 serving of guacamole and fresh salsa

Dinner — Pasta with pesto and beans

- 1 cup (140 grams) of brown-rice pasta or whole-wheat pasta
- 1 tablespoon (14 grams) of pesto
- 1/4 cup (60 grams) of cannellini beans
- 1 cup (20 grams) of spinach
- 1 cup (139 grams) of cherry tomatoes
- 1 tablespoon (5 grams) of grated parmesan cheese

Figure 2: Health report page


Background process

As application developers and administrators, we want to do some analysis based on the collection of the user data. In specific, we categorized the users into different groups based on the value of ages, gender, BMI, WHR, etc., in order to gain a better understanding of which group of people tend to use this application: Are overweight people more likely to use this system to keep track of their health situations and get some useful tips? Are underweight people more likely to register in this system? What about people that are already in good shape (They may want to use this app as a kind of workout motivation)? To make userdata available to administrators, we developed a background process for our application that can fetch all the userdata from our database and summarize into a well-formed user data report. This background process is triggered at 7 am every Monday, and the process would automatically generate a manager report and send it to the system administrators' email(the content of the email is shown in Figure 3.1). From the report, it implies the number of users in each category, and some average statistics across all the users are computed such as the average daily steps and average daily calorie consumption. In addition, the second part of the manager report shows the detailed information about each user, and considering the growing number of users in future, it only shows the detailed information for the most recent ten users. We can then furtherly update and improve our system based on the collected user data to provide better application using experience. For example, if we find out that overweight / underweight people are more likely to use our app, then we will include more meal plans in the system since the main goal for these people might be to lose / gain some weight. If we find out that people that


are in normal weight are more likely to use this app, then we will include more workout tips in our system because the main goal for these people might be to have a better body shape. Our background process was designed to deploy as a lambda function on AWS, but when we wanted to make this schedule lambda function using CloudWatch Events, we faced an unsolved problem to put roles(AccessDeniedException) as shown in Figure3.2. After searching for solutions from the internet, it seems the restriction of AWS student's accounts. Therefore, we decided to move the background process to be deployed on an EC2 instance(Shixiong's AWS Educate account). Please use the provided key file to SSH'd into this instance to get a better view of this process.




Figure 3.1: User data report



EventBridge (CloudWatch Events)
aws events management-tools



User: arn:aws:sts::213503413067:assumed-role/vocstartsoft/user990473=shixiong.gao@mail.utoronto.ca is not authorized to perform: events:PutRule on resource: arn:aws:events:us-east-1:213503413067:rule/Background-process-checking with an explicit deny (Service: AmazonCloudWatchEvents; Status Code: 400; Error Code: AccessDeniedException; Request ID: 9fb689fd-8a49-4c7c-beb0-c0028dfc9dae; Proxy: null)



Rule
Pick an existing rule, or create a new one.

Create a new rule

Select or create a new rule

Rule name*
Enter a name to uniquely identify your rule.

Background-process-checking

Rule description
Provide an optional description for your rule.

running process and check whether current time is required time

Rule type
Trigger your target based on an event pattern, or based on an automated schedule.

☐ Event pattern
☒ Schedule expression

Schedule expression*
Self-trigger your target on an automated schedule using Cron or rate expressions. Cron expressions are in UTC.

rate(1 minute)

e.g. rate(1 day), cron(0 17 ? * MON-FRI *)

Figure 3.2

Database schema

The database schema is shown in Figure 4 and Figure 5, where Figure 4 is the ‘user’ table that stores all the user registered information including email address, username and password and Figure 5 is the ‘userdata’ table that stores all the user’s input data and computed indicators including weight, height, BMI and so on. In the table named ‘user’, ‘email’ is both the partition key and sort key for the rest indexes. In the table named ‘userdata’, ‘time’ is the partition key and ‘email’ is the sort key for the rest indexes. We use AWS DynamoDB as our database server, which provides NoSQL database service.

<input type="checkbox"/>	email	password 	<input type="checkbox"/> user_name
<input type="checkbox"/>	qixuan.zhang@mail.utoronto.ca	481f6cc0511143ccdd7e2d1b1b94faf0a700a8b49cd13922a70b5ae28acaa8c5	Qixuan
<input type="checkbox"/>	shixiong.gao@mail.utoronto.ca	8d969eef6ecad3c29a3a629280e686cf0c3f5d5a86aff3ca12020c923adc6c92	Shixiong
<input type="checkbox"/>	2391724183@qq.com	cebe3d9d614ba5c19f633566104315854a11353a333bf96f16b5afa0e90abdc4	arnoldzhang

Figure 4: ‘user’ table

	time	email	BMI	WHR	age	blood_p	calorie	gender	heart_r	height	hip	sleep	step	user_name	vegetal	waist	water	weight
	2020-12-	qixuan...	17.3	0.88	20	100	98	Male	65	170	80	8	3000	Qixuan	50	70	2000	50
	2020-12-	239172...	17.3	0.88	23	100	98	Male	65	170	80	8	3000	arnoldz...	50	70	2000	50
	2020-12-	shixion...	17.4	0.8	23	150	102	Female	80	173	100	8	3000	Shixiong	50	80	2000	52
	2020-12-	qixuan...	17.2	0.66	20	100	196	Male	65	187	106	7	5000	Qixuan	30	70	2000	60
	2020-12-	qixuan...	20.8	0.88	23	100	118	Male	65	170	80	7	3000	Qixuan	30	70	3000	60
	2020-12-	shixion...	17.2	0.88	20	100	118	Male	65	187	80	8	3000	Shixiong	50	70	2000	60
	2020-12-	qixuan...	31.1	0.88	20	100	177	Male	65	170	80	8	3000	Qixuan	50	70	2000	90

Figure 5: 'userdata' table

Cost model

Case 1: 10 users

Assume that each user uses the application one time per day for half a year. During the use of this application, each user only inputs data once, which will generate around 100 requests in total. The cost model for this case is summarized in the table below.

Table 1: Cost model for 10 user case

Lambda cost (\$)		DynamoDB cost (\$)		Total cost
Duration cost	Request cost	Write Cost	Read Cost	
129	0.036	0.0023	0.0045	129.04

Case 2: 1000 users

The assumption remains the same as in the above. The cost model for this case in a six-month time duration is summarized in the table below.

Table 2: Cost model for 1000 user case

Lambda cost (\$)		DynamoDB cost (\$)		Total cost
Duration cost	Request cost	Write Cost	Read Cost	
129	3.6	0.23	0.45	133.28

Case 3: 1000000 users

The assumption remains the same as in the above. The cost model for this case in a six-month duration is summarized in the table below.

Table 3: Cost model for 1000000 user case

Lambda cost (\$)		DynamoDB cost (\$)		Total cost
Duration cost	Request cost	Write Cost	Read Cost	
129	3600	230	450	4404

Appendix

Health indicators calculation formulas:

- BMI:
BMI = mass in kilograms / height in meters ²
- WHR:
WHR = waist circumference / hip circumference
- Daily calorie consumption:
calories = mass in kg * daily steps * 6.54 * 10 ⁽⁻⁴⁾