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# Moods and Triggers

Diagram

Description automatically generatedI used a modified version [1] of Russell’s Circumplex Model of Affect [2] as the mood model for my project. I considered several other models.

Figure 1 Russell's Circumplex Model of Affect (Modified)

The Valence-Arousal-Dominance model [2] (also proposed by Russell) was a front runner, but it’s third dimension (dominance) added an unnecessary complexity that I felt would not add enough value to the project to warrant handling the third dimension and its extra complexity.

Another strong contender was the Emotional State Model - which attempts to enumerate the discrete emotional states such as Happy, Angry etc. This would fit well within the constraints of this project, but it seemed overly simplistic, and quite a lot older than the other two models I considered.

Russell’s Circumplex Model of Affect was particularly attractive as it allowed 2 axes (valence and arousal) and 4 categories with which to classify each “mood” - see Figure 1. This would be invaluable during visualization of mood logs.

For mood triggers I decided early on that the activities the user engaged in - that prompted the mood - would be appropriate. These triggers are sub divided into groups. Each user account, upon creation, is seeded with an Activity Group named *Default*, in which are nested two Activities – *Work* & *Exercise*. When a user engages in mood logging, they **(1)** Choose a mood valence (positive/ negative) and are shown all the moods within that valence **(2)** choose a specific mood then optionally **(3)** enter some text notes about the entry and **(4)** Select an activity – or multiple activities. Only the selected mood is mandatory, all other information is optional. Each mood entry is also assigned a date & time stamp when it is created in the database. The timestamp and mood itself are not editable after the fact, only the notes and activities can be changed.

# Authentication & Security

## Login

|  |
| --- |
| (browser -> web app)  POST /login HTTP/1.1  Host: <http://localhost:3000>  Content-Type: application/x-www-form-urlencoded  username=exampleusername&password=examplepassword |
| (web app -> API)  POST /api/auth/login HTTP/1.1  Host: <http://localhost:3000>  Authorization: Bearer *<<API key from environment variabless>>*  Content-Type: application/x-www-form-urlencoded  username=exampleusername&password=examplepassword |
| Figure 2 Example POST requests for login routes |

The web application manages authentication using JSON Web Tokens (JWTs). The user navigates to the login form, enters their username and password, and submits. The form then sends a HTTP POST request to the /login route of the web app. Internally this route‘s middleware packages up the submitted username and password into a new POST request to be sent to the API’s /api/auth/login route.

This POST request to the API is authorized via an API key. A unique secret API key is read from environment variables (or in my case a dotenv library .env file that contains key value pairs to be injected into the process.env global node object as if they were environment variables), and added to the Authorization header (figure x).

The API receives this request and attempts to authorize the request via the middleware authenticateRequestBySource.

This middleware reads the Authorization header from the request, then queries the database tbl\_key table to check if the key valid – i.e. that is it both exists and has its active bit(1) attribute set to 1.

* If the key is valid (present and active), the request is authorized by the middleware and next() is called to move onto the next route specific middleware.
* If the key is not valid, then the API returns a status code 401 (Bad Request) and an accompanying JSON response body (modelled by my SuccessResponse class) indicating the request is not authorized and was rejected. This logic will be discussed below.

Once the middleware has authorized the request the login middleware is called. This middleware is mounted in the /api/auth/login POST route in the API’s authRouter.

This middleware then processes the request as follows:

The POST body is validated to contain the required properties (username and password). If it does not, a 401 response is returned with a JSON body modelled by my LoginResponse class, which indicates the login attempt’s success with a boolean, and optionally token and error properties. The latter being an array containing various validation error messages (eg. “no username provided”).

If the post body is valid, then the middleware calls a method of my AuthApiDataAccessObject class – also named login, passing in the provided username and password as parameters. This data access object exists to maintain separation of concerns. All authentication database queries/ statements are housed in this data access object.

This auth DAO first confirms the user exists by querying the database for user data for users with the username equal to the POST body username property.

If the user does not exist, a 401 is returned with an appropriate error message (i.e., “This username does not exist”). If the user does exist then the password submitted during log in is hashed with the same salt as the stored password from the database, and the submitted and stored passwords are then compared for equality.

If the username and password combination is accepted, the API constructs a JWT with a payload containing the user’s username, email, and id (id primary key from DB), and an expiry date/time stamp in the form of a Unix time stamp.

|  |
| --- |
| {      "success": true,      "token": "eyJhbGc…0Bi31Cg"  } |

Figure 3 Example Success Response (JWT shortened for readability)

The API returns a status of 200 with a JSON body to the web app that contains the JWT as one of its properties (e.g., figure x). The web app receives this response, and if the success property is true, and the response contains a token property, the token is retrieved and stored in a cookie on the user’s machine named token.

If the success property is false, the loginfailed.ejs template is rendered with a 401 status code. If the success property is true and the token property is undefined, or otherwise falsy, the user is redirected to the /500 route in the fallbackRouter (with a status also set to 500). This indicates to the user that an error has occurred on the server.

This describes the basic method by which a user is authenticated.

## Authenticated Users & Restricted Areas

When a user attempts to access any part of the web site, a middleware function named authenticate then attempts to the read the JWT from the token cookie and verify it. It does so by attempting to decode the token into a plain JSON object using a secret key. As cryptography is an area of utmost importance, and the technical level required to implement it safely is relatively high, I decided to install and import the jsonwebtoken node module. This gives us access to the verify() and sign() methods, which can be used to verify/decode and create JWTs respectively. I’ve wrapped the use of these two functions in my own custom jwtHelpers.ts module, so that changing the library used to sign and verify tokens can be done relatively easily – by editing this single module.

|  |
| --- |
| function verifyToken(token: string): JwtPayload {    return jwt.verify(token, process.env.MOODR\_TOKEN\_SECRET!)  as JwtPayload;  } |
| Figure 4 the jsonwebtoken node module allows us access to the verify method. This method allows us to decrypt and read the payload of the JWT using a secret. In my project you can see the secret (2nd arg – in red) is read from environment variables/ dotenv .env file |

In my project this secret is in the form of a single unchanging value that is accessible in this jwtHelpers.ts module via the verifyToken() (figure x) and createToken() methods. This module is imported by both the web app (in the middleware authenticate) and the API (in the middleware authenticateRequestByJwt and in the class AuthApiDataAccessObject), allowing both to process these JWTs in the same manner. In reality both the API and web app would be deployed with the secret in a configuration file, and not be so tightly coupled to a utility method directly like this.

In the authenticate middleware An ExpressJS local variable inside the ExpressJS Response object is declared, if the token was successfully verified, it is initialised to true, and otherwise to false. This expressJS local boolean serves as the flag by which the site may decide to permit access to a given route (note all variables assigned as properties of the res.locals object are then accessible in the template files. res.locals.example set in a middleware function is then accessible as example in a template rendered by that route). All authentication-restricted routes call another middleware function named restrictedArea, that checks this flag, and if it is falsy (e.g., null, undefined or false - among others), then the user is redirected to a /forbidden route, that simply informs the user this route is forbidden without a successful login.

Using this methodology, my web application’s login-restricted routes can allow access to authenticated users only.

## API Authentication

The API has a primary method of authorization for requests originating from the web application’s server/ back-end and another secondary method for HTTP requests that are originate from client-side script charts.js.

The primary method of authorization is via that of an API key set in the Authorization header.

that is a in the Authorization header as a Bearer token. DB API KEY IMPROVEMENT CRAIC HERE. where it can access the username, email, id and expiry data within. This API key is accessed as an environment variable on my PC, which enables me to keep it from appearing within the repository, a relatively common security lapse.

This key is kept in a .env file in the root directory of the project. It is then injected into the process.env global object in node, where environment variables are read from the system and stored for use in node applications.

This API key is available only to my web app’s backend, meaning the only resource authorized to consume my API is the web app, or any other application I share this key with. In this way the security of the database, and the data within is maintained.

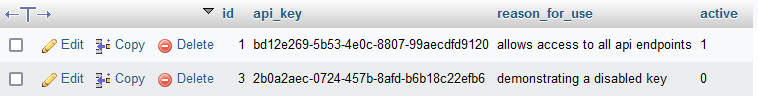
If the current time exceeds the expiry time of the JWT then the token is cleared from the user’s computer, logging them out.

|  |
| --- |
| const opts = {          method: httpMethod,          body,          headers: {              'Content-Type': 'application/x-www-form-urlencoded',              'Authorization': 'Bearer ' + process.env.REQUESTOR,              ...(token && { 'Cookie': 'token=' + token })          }      };  const fetchResponse = await fetch(buildApiUrl(endpoint), opts); |
| Figure 5 How the web app makes requests to the API – note the process.env.REQUESTOR environment variable which contains the API key. | |

In this snippet, takEN from my apiCall() method utilized by the website backend to make HTTP requests to my API, we can see highlighted in red, where this API key is read from environment variables and used as a Bearer token for the API.

# REST API

All database operations performed by the web application are done so through a RESTful API. This API is also an ExpressJS application like the main web application. It is divided into 3 ExpressJS Routers - *authRouter, moodRouter* and *visualizeRouter*, to maintain separation of concerns. As discussed in the [Security](#_Authentication_&_Security) section, requests to the *authRouter* and *moodRouter* are authorized via API keys and the *visualizeRouter* is authorized via JWT– both sent as Authorization headers.

 Currently my database has a table named *tbl\_key* (Figure 6), in which are stored API keys that the API will accept. New API keys can be added simply by inserting into this table. Old/ current keys can be deactivated by simply updating the active bit(1) attribute to be 0. The code in the API that checks the Authorization header for this API key can be seen in Figure 6. The API retrieves the Authorization header prior to this line, and forms a prepared SQL statement which checks both the key exists, and is currently active. The *format()* function is provided by the mysql2 node module/ library, and allows us to prepare SQL statement with escaped strings, to prevent SQL injection attacks. In this manner a key may be deactivated once compromised, or of a certain age.

|  |
| --- |
| const sql = format("SELECT COUNT(\*) AS `count` FROM tbl\_key k WHERE k.api\_key=? AND k.active=1", [authHeader]);  // evaluates to  // SELECT COUNT(\*) AS `count` FROM tbl\_key k WHERE k.api\_key='bd12e269-5b53-4e0c-8807-99aecdfd9120' AND k.active=1 |

Table

Description automatically generated

Figure 8 Current API Keys

Figure 6 API authentication code

Figure 7 API Check code

The database is then queried and if the key does not exist, or is not active (*count* returned is 0) then the API key is rejected, and a 401 Not Authorized status is returned with a request body modelled by my *SuccessResponse* class.

Figure 9 API Keys storage in DB

|  |
| --- |
| {      "success": false,      "errors": [          "You are not authorized."      ]  }  Figure 10 Not Authorized SuccessResponse |

If the key does exist, and is active (*count* return is not 0), then the *next()* Express routing callback function is invoked, which moves the now authenticated request onto the next relevant route.

# References

1. Accessed date. 31 Jan 2023 [Online]. Available: <https://ascelibrary.org/cms/asset/4f61d617-0684-42de-9120-1cb8d15e3734/figure1.jpg>
2. Posner J, Russell JA, Peterson BS., “The circumplex model of affect: an integrative approach to affective neuroscience, cognitive development, and psychopathology.” Dev Psychopathol., May 2005 Accessed: Jan, 01, 2023, doi: 10.1017/S0954579405050340. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2367156/