VIETNAM NATIONAL UNIVERSITY – HO CHI MINH CITY

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SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

THESIS REPORT

Nguyễn Thành Thiện

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SPORT EVENTS MANAGEMENT MOBILE APP

by

NGUYEN THANH THIEN

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APPROVED BY SUPERVISOR

APPROVED BY: COMMITTEE

Tran Thanh Tung, Ph.D.

Assoc. Prof. Chair Tran Manh Ha,

Thesis committee

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I. INTRODUCTION

1. Objective

With the development of society, the application of modern technology is more and more popular in our world, especially of using phone in daily life. Today's phones can meet most user requirements, from keeping contacts, taking photos/videos to serve entertainment purpose such as music, games, etc.

One of the benefits of a modern phone (smartphone) is that users can select their favorite applications and use them independently as regular web applications.

Applications that are the most popular have basic requirements such as tracking the status of an in-app object, finding an object, controlling personal information from the application and the interaction between users and apps, etc.

With my product (called "Sport News"), you can use the functions needed for specific sport community events in your area.

2. Problems and Solutions

** Problems:*

- With customer:

    + There are too less applications that used to track community sports events in smartphone.

    + It is difficult to keep tracking favorite kind of sports.

+ The event positioning system has not been applied.

+ Review tournaments with pictures is hard.

- With owner:

+ Upload event into native mobile application is limited.

+ Hard to manage the events in smartphone.

* *Solution:*

- Realtime Push Notifications about the event into customer’s phone.

- Capture their moment using to review the event.

- Tracking events by real time map and GPS.

- A web application for event’s hosts.

3. System requirements

3.1. React (React Native and ReactJs)

- React was introduced and developed by Facebook, the biggest community network in the world. React was created to optimize the DOM handling (by saving the state of an application and just change the DOM when state changed). By this way, it is really helpful with constant data.

- Beside that, React Native is a framework that lets you build native iOS and Android apps with one unique language of Javascript. React Native provides a virtual DOM (Document Object Model) which is a generic representation of what your UI will look like independent of the two platforms. React Native then renders the native control based on your UI markup representation which then renders native controls. It is able to take native platform components (sliders, switches, labels, tab bars) and wrap them in React component counterparts.

3.2. Why React Native

3.2.1. Saving time and reducing development costs.

** Easy to learn*

- Getting started with React Native is easy - especially for JavaScript professionals. Just download the open-source code from Github and make sure you’re familiar with a few tools and constructs in the React Native library including NodeJS, the CSS Flexbox system, ECMAScript 6, and JSX.

* Cross-platform

- React Native was originally only developed for iOS support, but due to its success and popularity, Facebook decided to develop support for Android as well, so which translates to lower development costs.

** The ability to combine good features and build apps*

- Whereas native app development is usually associated with inefficiency, less developer productivity, and slower time to deployment, React Native brings the speed and agility of web app development to the hybrid space with native result (the combination between pros of Hybrid and Native apps).

- React Native provided "Hot Reloading" (the previous version is “Live Reloading”) that keeps the app running and to inject new versions of the files that you edited at runtime. By this, you don't lose any of your state which is especially useful if you are tweaking the UI. The result is times between you save a file and be able to get this feedback loop can be under 1 second, even as your app grows.

3.2.2. Performance

- Traditionally, “Hybrid” or “Mobile web” apps that work on both iOS and Android tends to go down for more complicated apps. Apps built through React Native are compiled into natively written code, so they not only work on both operating systems, but also function the same as a natively written app (**“learn once, write anywhere”**).

- React Native is focused solely on building a mobile UI, making it more like a JavaScript library than a framework. It is developed based on Facebook’s popular ReactJS UI library for web applications, so it brings all of ReactJS’s better app performance: DOM abstraction, and simplified programming methods to hybrid mobile development. The resulting UI is highly responsive and feels fluid (the app will have quicker load times than a typical hybrid app, and a smoother feel) thanks to asynchronous between Javascript and Native.

3.2.3. Reusability

- Reusability is key in React Native. That mean the building blocks are treated as native components that can be compiled directly into the native languages (Objective-C for iOS and Java for Android). This is a huge bonus for businesses that want to augment an existing app but don’t want to overhaul it by Incorporate React Native components into the app’s code.

- This is possible to exclude the WebView components of other Hybrid mobile apps because React Native’s building blocks are reusable “native components” that compile directly to native. For example, if you’re adding Google Maps functionality to your app, React Native lets you link the plugin with a native module without have to rely on a WebView for certain functions. Components you would use in platforms have counterparts right in React, so you'll get a consistent look and feel.

3.2.4. Maintainability

- React Native uses Javascript and this, coupled with the intuitive architecture of the framework itself, allows engineers to jump to and from each other's projects on Native apps with relative ease.

- The typical workflow would consist of writing most of the code on React Native and then using the native languages to optimize certain elements of the app. Parts of a specific app written in React Native will have no trouble combining with parts written in the native languages for iOS or Android. It is completely up to the developer to build the app, it not only can the native languages of an OS be used to optimize an app, they can also be used to write parts of the app.

4. Goal

After developed the project, I want to gain the needs that:

- Having an application for user to track sports community events (in both client-server sides).

- Using React to build application (on both smartphone and web environment) with smoothly.

- Applying Firebase into future projects as a steady server to store and analyze data.

II. BACKGROUND

1. Flux and Redux

1.1. Flux

- Flux is an architecture for creating data layers in JavaScript applications. It was designed along with the React view library. It places a focus on creating explicit and understandable update paths for your application's data, which makes tracing changes during development simpler and makes bugs easier to track down and fix.

- Flux consists of the following basic components:

+ **Action:** This is the place to register the functions that will be called when View needed.

+ **Dispatcher:** Has the role of transmitting calls from Action to the Store. When an Action is called, the Dispatcher will broadcast an event to all Stores, with Action Type, or any other required data.

+ **Store:** The place to store data, is also the only place where you can add, edit or delete data. The store will listen to the events that come from the Action through the Dispatcher, check that the event is under its processing, and make the necessary data changes, corresponding to each event. After changing the data, Store will give another event to report its change.

+ **View:** Retrieves data from functions.

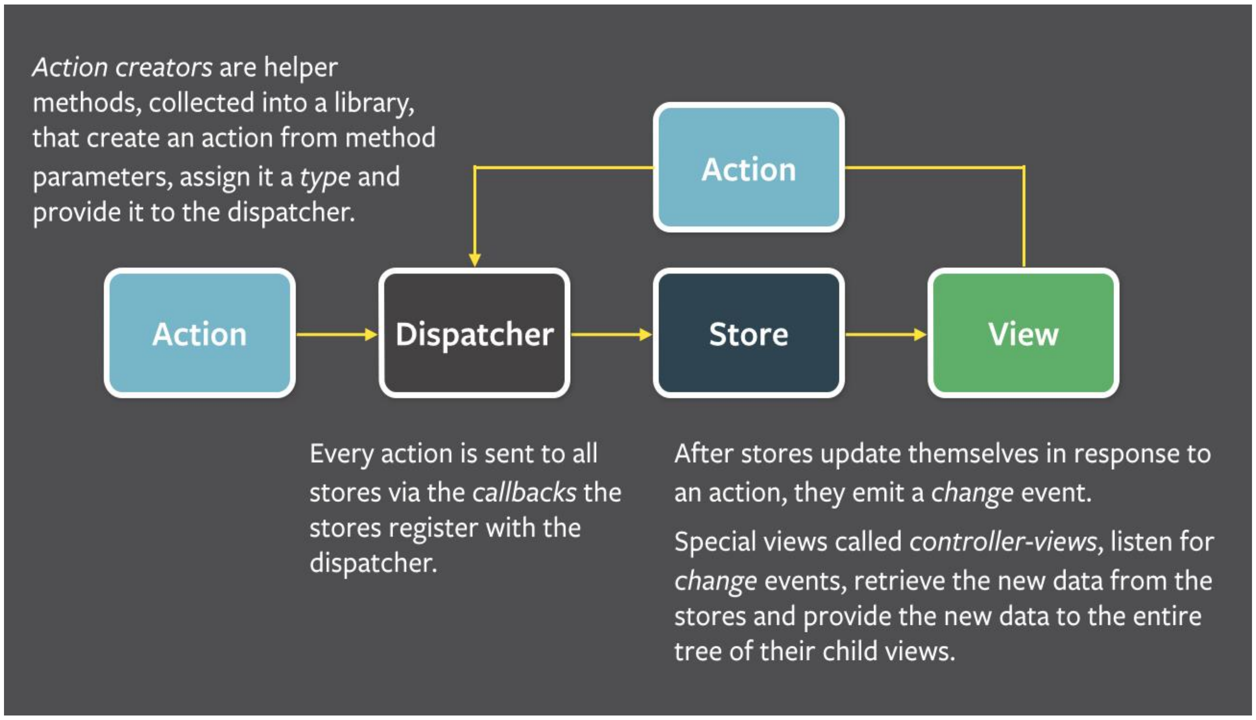

Action creators are helper methods, collected into a library, that create an action from method parameters, assign it a *type* and provide it to the dispatcher.
Action
Action
Dispatcher
Store
View
Every action is sent to all stores via the *callbacks* the stores register with the dispatcher.
After stores update themselves in response to an action, they emit a *change* event.
Special views called *controller-views*, listen for *change* events, retrieve the new data from the stores and provide the new data to the entire tree of their child views.

Figure – Flux architecture

- React using **one-way data bindings**, because they think that two-way data bindings will become "When one object update, it many other objects will update, and then makes more updates". With one-way, when all the changes go to the Dispatcher, they can easily find where the change comes from, so the system will become "predictable".

- Flux follows the concept of **Unidirectional Data Flow** (UDF is to keep the data flow in the application moving in a single direction. When the data changes, this stream reboot from scratch) making it much easier to zero in of where the error lies. The data goes through a strict pipeline through your application:

+ Any changes, or Actions, **must go** through the Dispatcher!

+ Store is just only public getter, not public setter. Data change handlers can only be called inside the Store itself. This means:

+ You cannot change the data in the Store directly from the View.

+ You also can not change the data in one Store from another. As mentioned above, Store is not public setter. To do that, you must go through Action and Dispatcher. This makes the data inside your Store more manageable, you can easily debug where the change comes from when data changes.

1.2. Different of Flux with MVC

** Easier to understand the data flow.*

- In the bidirectional data flow, you have the typical data flow MVC. But when applications became more complex, the Controller takes the huge responsibility of maintaining both the application state and the data. Also, the cascading updates makes the app really difficult to understand and debug.

- With UDF, changes in the application view layer will trigger an action in the data layer. These changes will then be reflected in the View. The View does not directly affect application data.

** Reducing the role of Controller.*

- Dispatcher is not a controller, it does not contain business logic. It simply is a "coordinating center", which send an Action to every Store. In the MVC model, you can design any Controller as you can. But in Flux, there is only one Dispatcher and all Actions must go through it. The appearance of the Dispatcher is important because it ensures the design of UDF.

** Store can handle many objects.*

- In the MVC model, the Model usually manage a particular object. In opposition to the Model, the Store may not handle any data or handle multiple states of the application, or manage multiple objects at once.

1.3. Redux

- Redux is an implementation library of Flux with minimal API but completely predictable behavior, so it is possible to implement logging, hot reloading, time travel, universal apps, record and replay, without any buy-in from the developer.

- Redux can be used together with React, or with any other view library, and following 3 principles:

+ All application state is contained within a ***single store***, which is most often a JavaScript object.

+ The application's state is ***immutable***. This means that at no point should the object representing the state be modified in any way by any component.

+ All functions that compute the new state (called reducer functions) must be **pure functions**. Pure functions are functions that produce no side-effects and are deterministic - for a given set of inputs, the output will always be the same.

- General structure of Redux design pattern:

+ ***actions*:** Are payloads of information that send data from your application to your store. They are the only source of information for the store

+ ***reducers*:** Reducers specify how the application's state changes in response.

+ ***stores*:** The actions that represent the facts about "what happened" and the reducers that update the state according to those actions. The Store is the object that brings them together.

+ ***components:*** Folder contains the components that is only responsible for view and receive user interaction (How things look: markup, styles). These files read and change data from *props* => Dump components.

+ ***container:*** The components that are aware of Redux, Router, etc. They are more coupled to the app. They transmit the data to dump components with *props* (How things work: data fetching, state update) => Smart components.

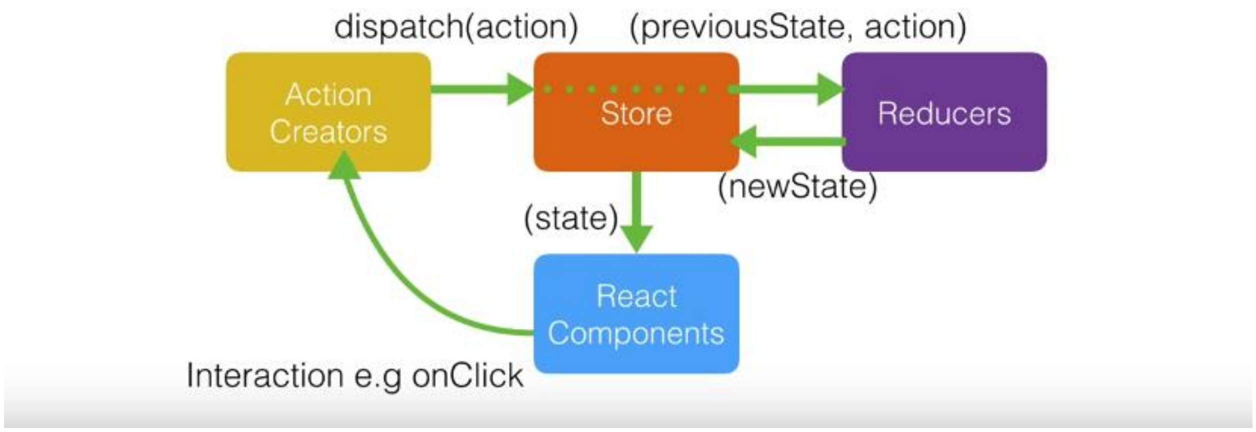


Figure – Redux life cycle

2. Node.js

2.1. Definition

Node.js is a compilation of Google's V8 JavaScript engine and great library environment for executing JavaScript functions outside the browser. It is also a helpful multi-platform to create a web applications and server-side. Node.js provides a great model which makes it become very lightweight, and can do smoothly with information serious. It also has a rich JavaScript's library modules to decrease the complication of applications.

2.2. How Node.js works

- It uses non-blocking, event-driven I/O paradigm to stay lightweight and valuable to handle real time problems and multi-client side.

=> Node.js is just a platform to server several kinds of needed.

- To optimize the lightweight feature, and then it is possible to expand a huge number of connections quickly with high instability.

- Node.js operates a single thread for all concurrent connections => Help to reduce the weight of RAM which was really a big problems of traditional web services when they always create new thread for each connection.

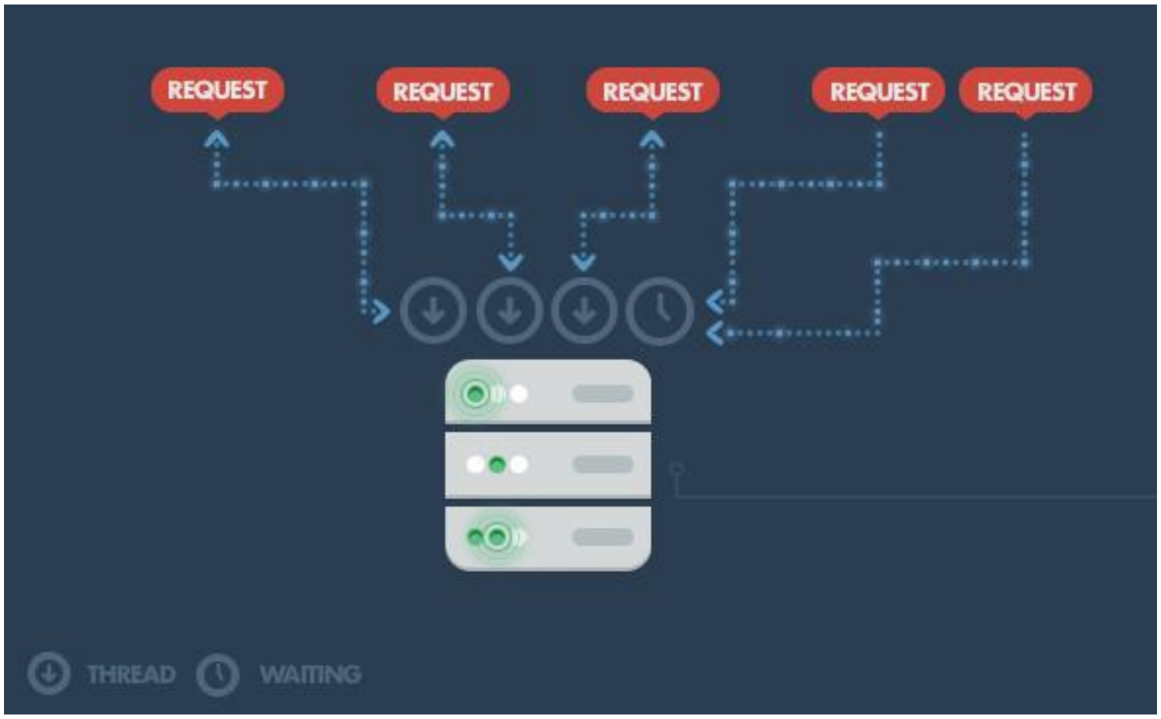


Figure - Traditional web-serving techniques

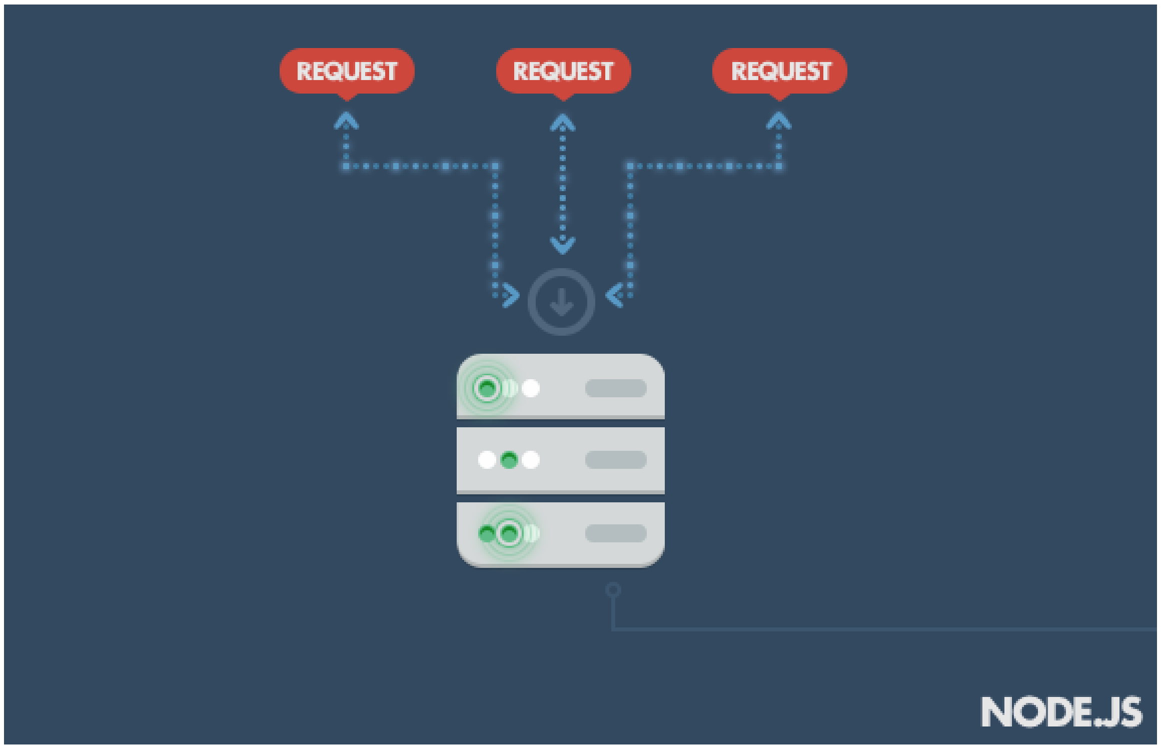


Figure - Node.js workflow

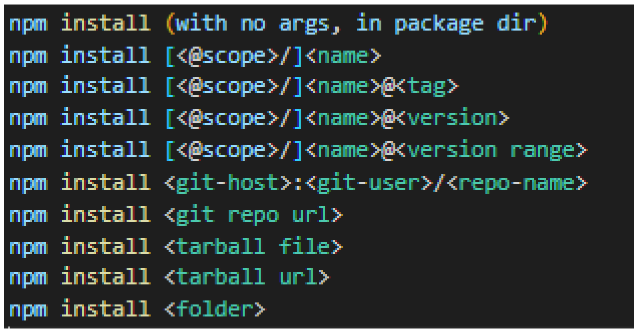
2.3 Node Package Manager – npm

- npm is a tool go with every Node.js version. It is a built-in support for package management. It includes set of all needed dependencies, publicity and reusable components with versions stored at an online reposistory.

=> Using npm CLI to install a huge module ecosystem, even publish your own modules.

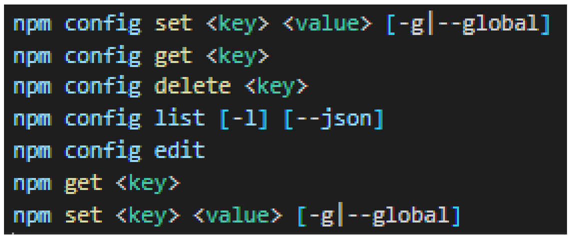
- To use npm CLI, pass following command pattern:

```
npm <command> [args]
```



```
npm install (with no args, in package dir)
npm install [<@scope>/]<name>
npm install [<@scope>/]<name>@<tag>
npm install [<@scope>/]<name>@<version>
npm install [<@scope>/]<name>@<version range>
npm install <git-host>:<git-user>/<repo-name>
npm install <git repo url>
npm install <tarball file>
npm install <tarball url>
npm install <folder>
```

Figure – npm install commands



```
npm config set <key> <value> [-g|--global]
npm config get <key>
npm config delete <key>
npm config list [-l] [--json]
npm config edit
npm get <key>
npm set <key> <value> [-g|--global]
```

Figure – npm config commands

- To fix installed modules by default, using command:

```
npm audit fix
```

- In React project, using npm is a fundamental part and through npm, we can find more helpful modules to develop and optimize application .

3. Firebase

3.1. Cloud Function

- Cloud Function will trigger a function (backend code) to run HTTPS requests, and Firebase features automatically. It likes a tool help to manage your server, and your code is stored in Google's cloud.

3.1.1. Definition

- Cloud Function is an event-driven computing service and does not need a server. Instead of having basic infrastructures such as servers, storage and other resources, developers can use Cloud Function to implement and initialize functions in Google's public cloud.

3.1.2. Using Cloud Function

- A Life cycle of function includes:

+ Define a new function (two support languages for writing are Javascript and Typescript) -> Choose an event provider -> how to execute the function.

+ Deploy function, Firebase will automatically connects to provided event.

+ When function's conditions is called -> functions is deployed -> The code is invoked.

+ Google will handle the sessions of function, if there are many events -> create more instances and vice versa.

+ When function is updated, all old versions will be replaced by the new one.

+ When the function is removed, all things will be cleaned up, including the connection between function and provided event.

- So we can say that it is implemented by 3 steps:

+ Set up: Install Firebase CLI and initialize Functions in the project.

+ Implement: Write the function by Javascript/Typescript language.

+ Deploy or update: Using CLI to deploy function and view log in the Firebase console.

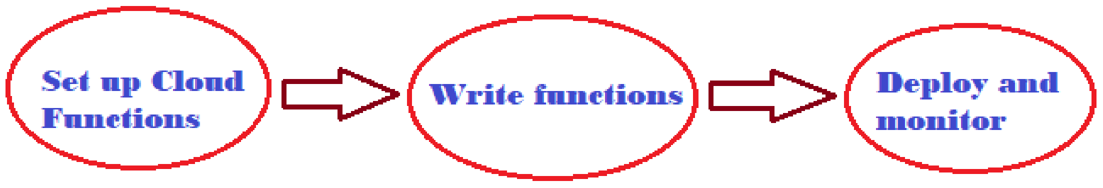
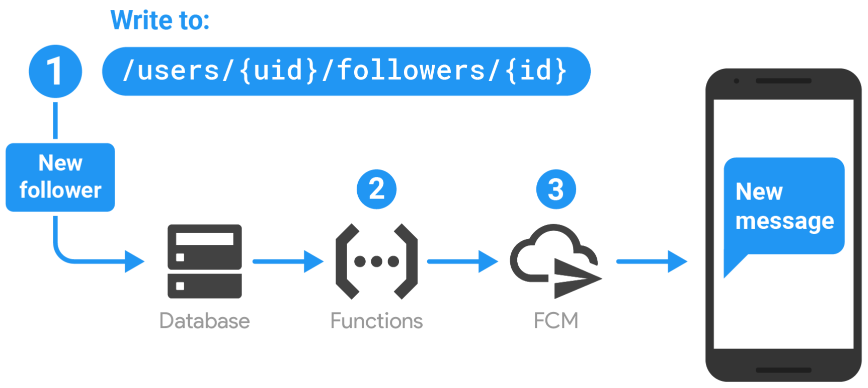


Figure – Cloud Function implementation path

* Usage of Cloud Function:

- Notify users when something interesting happens:

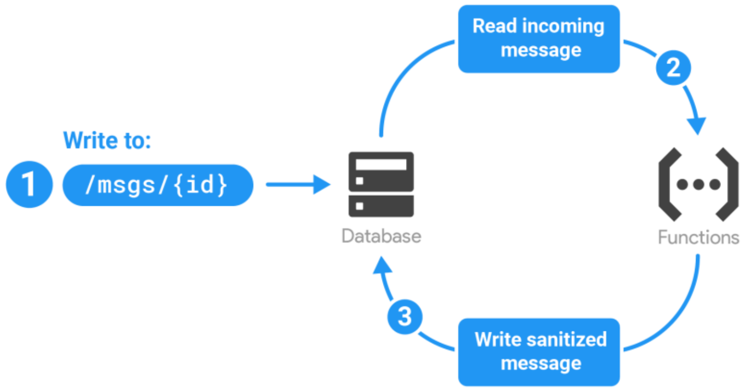


+ The function is triggered when database was updated.

+ Function execute to compose a message to send by using Firebase Cloud Messaging.

+ When Firebase Cloud Messaging is executed, a notification is sent to user's device.

- Perform Realtime Database sanitization and maintenance

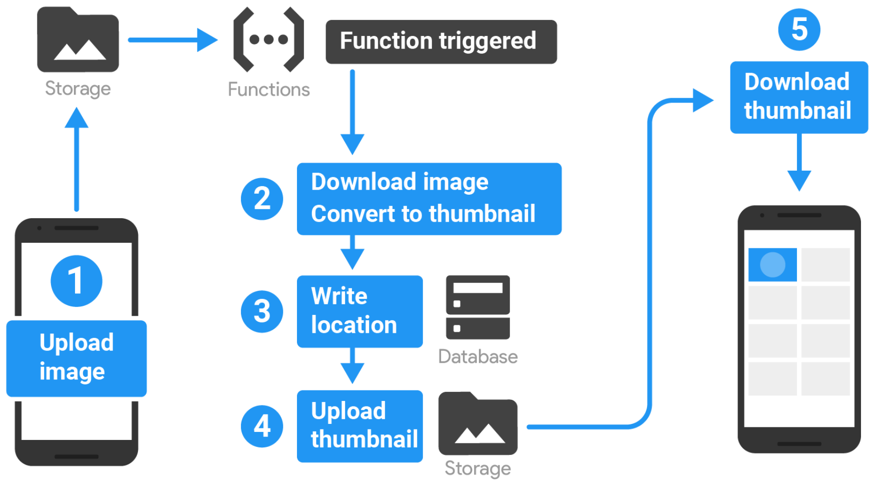


+ The function is triggered when database is written to store -> retrieving event data containing the text message.

+ Function execute to detect and handling text message.

+ Function send back an update to database.

- Execute intensive tasks in the cloud instead of in your app



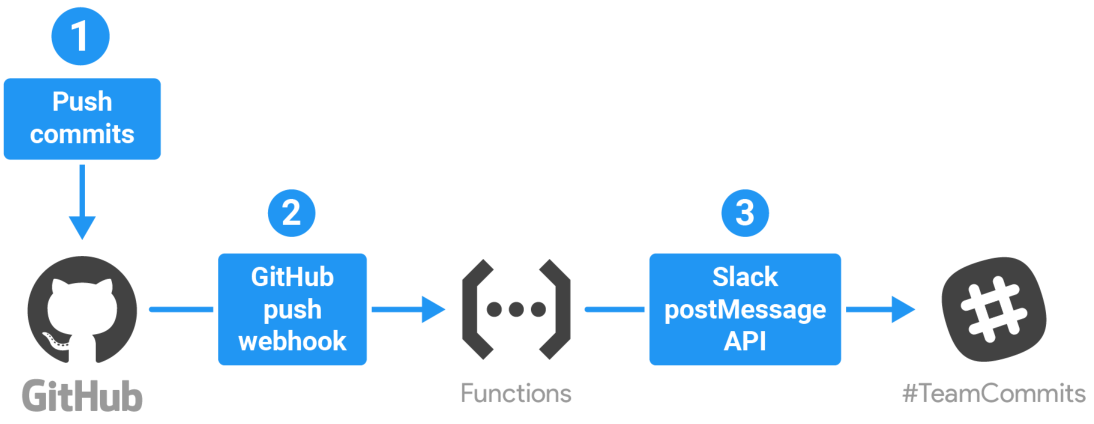
+ When image is uploaded to storage -> a function is triggered.

+ Image is downloaded and convert to thumbnail (resizing/cropping).

+ Function save that thumbnail's location into database -> client side can interact with thumbnail's location.

+ Thumbnail is uploaded back to new location -> download via thumbnail link.

- Integrate with third-party services and APIs

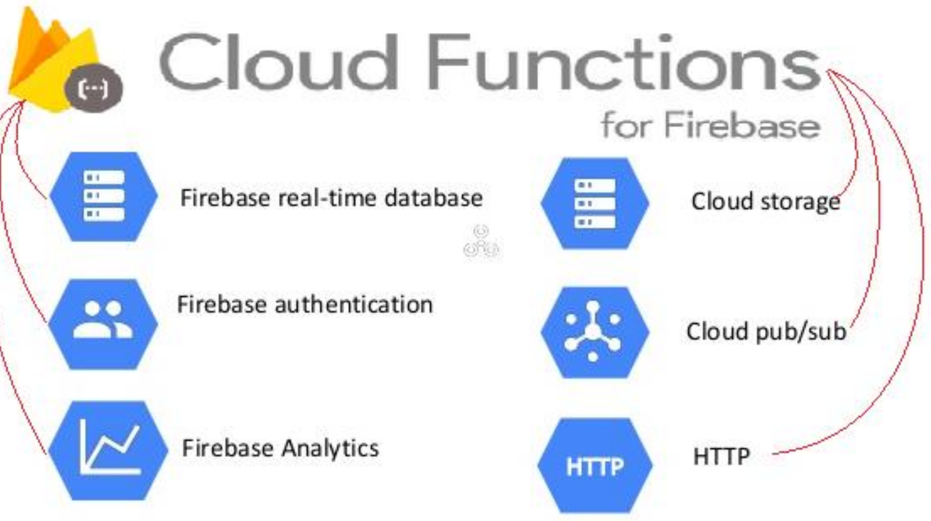


+ When a commit is pushed into Git -> function is triggered via Git webhook API.

+ Function send notification (Slack postMessage API) into Slack.

3.1.3. Why Cloud Function

- Cloud Function can integrate with other features of Firebase and respond to the created event, helps to limit ordinary code and making easier to use Firebase.



- Server configures automatically and scales up the resource. After deploy function, The problems of server connection or server credentials is executed automatically.

- Cloud Function fully isolate with client side, so logic function is secured and avoid the code to be reverse engineered.

3.2. Real time database

3.2.1. Definition

- Firebase Realtime Database is a cloud-hosted database, using real time to update and receive newest data between clients – server.

- Is a NoSQL database and as such has different optimizations and functionality compared to a relational database. Data is stored as Json object and synchronized in real time to every connected client.

- Data is remain unchanged when clients go offline.

3.2.2. Using Realtime Database

- You can build an application with secure access from client, and give the responsive experience and even if client goes offline, it can automatic merge and conflict.

- Realtime Database uses Security Rules as an expression-based rules language to limit how data can be read and written. We can integrate Realtime Database with Authentication to manage the data accession.

- Data can be used to build a massive experience of real time to users and no need to worry about compromising on responsiveness. Realtime operation is executed very quickly and then can optimise the functionality.

- Firebase Realtime Database implementation path:

    + Integrate Firebase Realtime Database: Using Gradle (Java Android), CocoaPods (Swift iOS) or Javascript (React).

    + Set up data (create/remove/update): Using Json object structure to create data references.

    + Database event: Listen even to write data or change data.

    + Enable Offline Persistence: Allow data to be written to the device's local disk so it can be available while offline.

    + Secure data: Using Security Rules to define who can read or write the data of application.

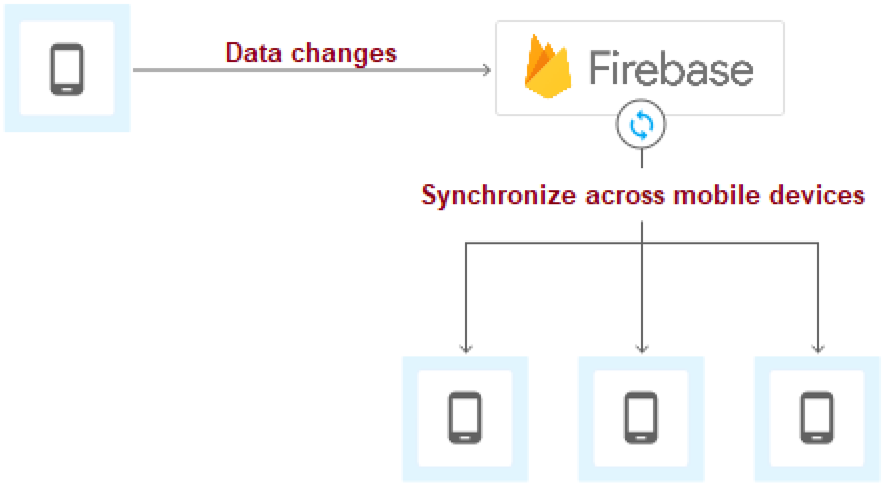
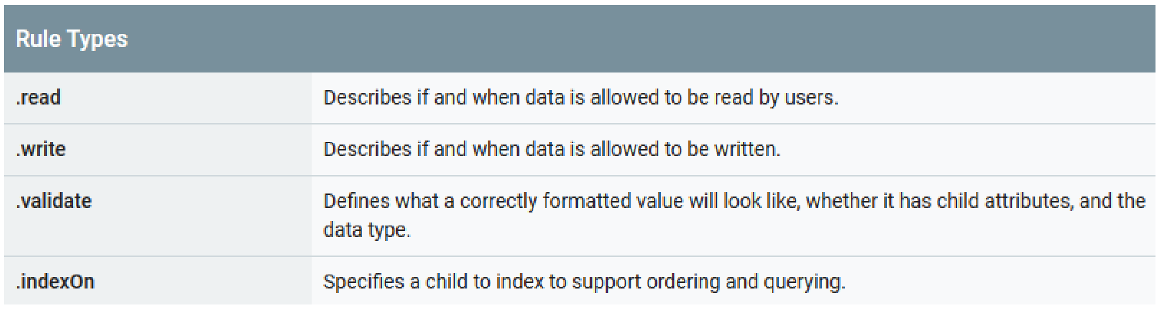


Figure – Database is synchronized at real time

* Firebase Realtime Database Rules:

- Security Rules has four types with Javascript-like syntax



Rule Types	
.read	Describes if and when data is allowed to be read by users.
.write	Describes if and when data is allowed to be written.
.validate	Defines what a correctly formatted value will look like, whether it has child attributes, and the data type.
.indexOn	Specifies a child to index to support ordering and querying.

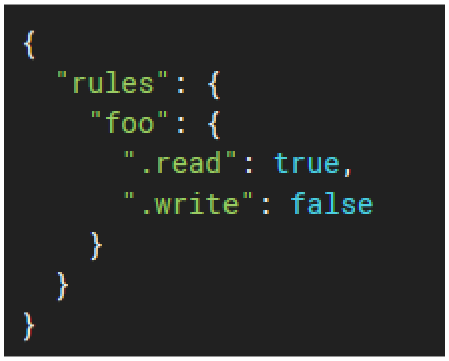
Figure – Four types of Security Rules

- To set your own rule to protect the database and set permissions authentication.

- There are several kinds of security to run application:

+ Authentication: A security concept to identify users. Using authentication to accept that user information is possible to run application.

+ Authorization: After Authentication, use Authorization to allow user access to the data, respectively. Authorization help to determine whether user can only read data or have permission to write and change data.



```
{
  "rules": {
    "foo": {
      ".read": true,
      ".write": false
    }
  }
}
```

Figure – Rules of user data accession

+ Data validation: Firebase Rules apply validation logic to help the data become consistent, it is called validation rules and it does not cascade => must evaluate to true in order for the write to be allowed.

+ Defining database indexes: Before launching your app though, it is important to specify indexes for any queries you have to ensure they continue to work as your app grows [3].

3.2.3. Why Realtime Database

- Data is synchronozed every time data changes and with a lightweight APIs, the data speed updated to clients is counted by milliseconds

- Firebase apps remain responsive even when offline because the Firebase Realtime Database SDK persists your data to disk. Once connectivity is reestablished, the client device receives any changes it missed, synchronizing it with the current server state [4].

- Based on Security Rules, we can determine whether or not data is access from clients so that it can be accessed directly from client side (mobile devices or web application) and do not need a server side.

- With Firebase Realtime Database on the Blaze pricing plan, you can support your app's data needs at scale by splitting your data across multiple database instances in the same Firebase project. Streamline authentication with Firebase Authentication on your project and authenticate users across your database instances. Control access to the data in each database with custom Firebase Realtime Database Rules for each database instance [5].

3.3. Authentication

3.3.1. Definition

- Firebase Authentication gives you a backend services to identify users, then makes user data become personalize.

- It provides good libraries to identify user by passwords, phone numbers, mails and even popular web services like Google, Facebook, etc.

3.3.2. Why Authentication

- Easy to develop your application’s Login page. By using Authentication, sign-in functions will work quickly and efficiently.

- A drop-in authentication solution to identify by username - password or any identification methods.

- The best solution for mobile and web application render sign-in UI. Go with that are other problems related to account like account linking, account recovery and sign-up function etc.

- It is customizable. Developers are not constrained in realizing the user experience.

4. Expo

- Expo is a set of tools, libraries and services help to develop mobile application using React Native.

- Expo uses React natives apps contain its SDK, which provides your accession to device's system functionally (camera, contact, local storage, GPS, etc.).

- It also offers simple UI components used for a mobile app such as Text, Touchable, View, etc.

- Expo SDK provides access to services and calls some general functions like Push Notification, Sign in with Google/Facebook, etc., and you can build native code within your React Native project using Expo efficiently.

4.1. Expo CLI

- Expo CLI (command-line interface) is a developing tool associated with UI and Web Browser, which can show the project's logs and device information to manage and develop the application.

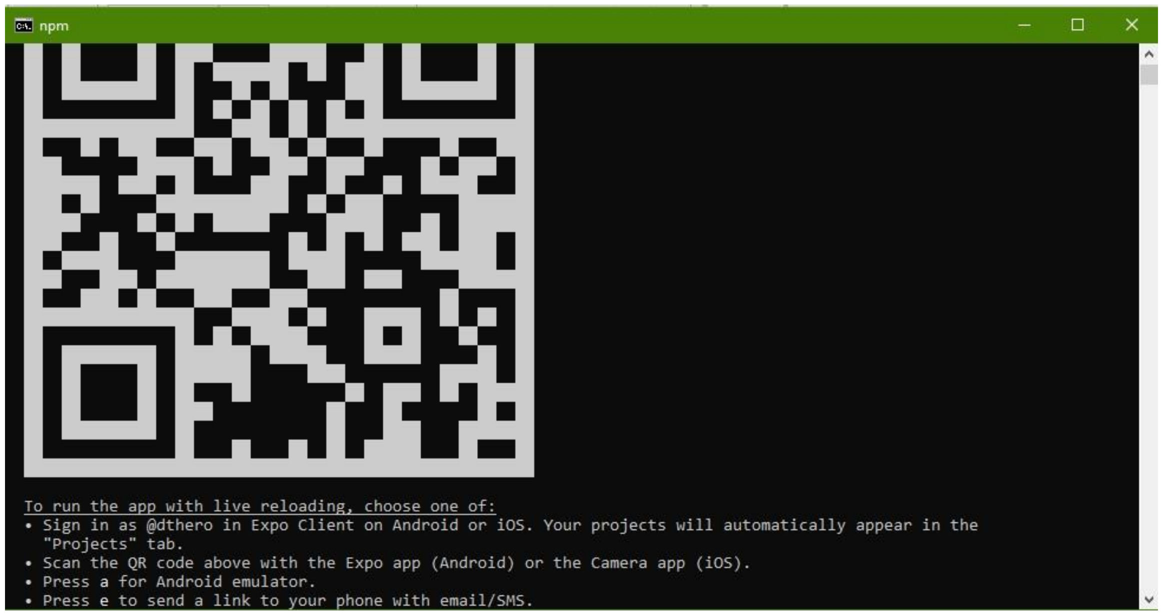
- To use Expo CLI, you first must have NodeJS (version 6 or newer) in your environment.

- First install Expo CLI, run command:

```
npm install -g expo-cli
```

- After installed Expo CLI, and start an Expo project by run following commands:

```
expo init <project_name>
cd <project_name>
expo start
```



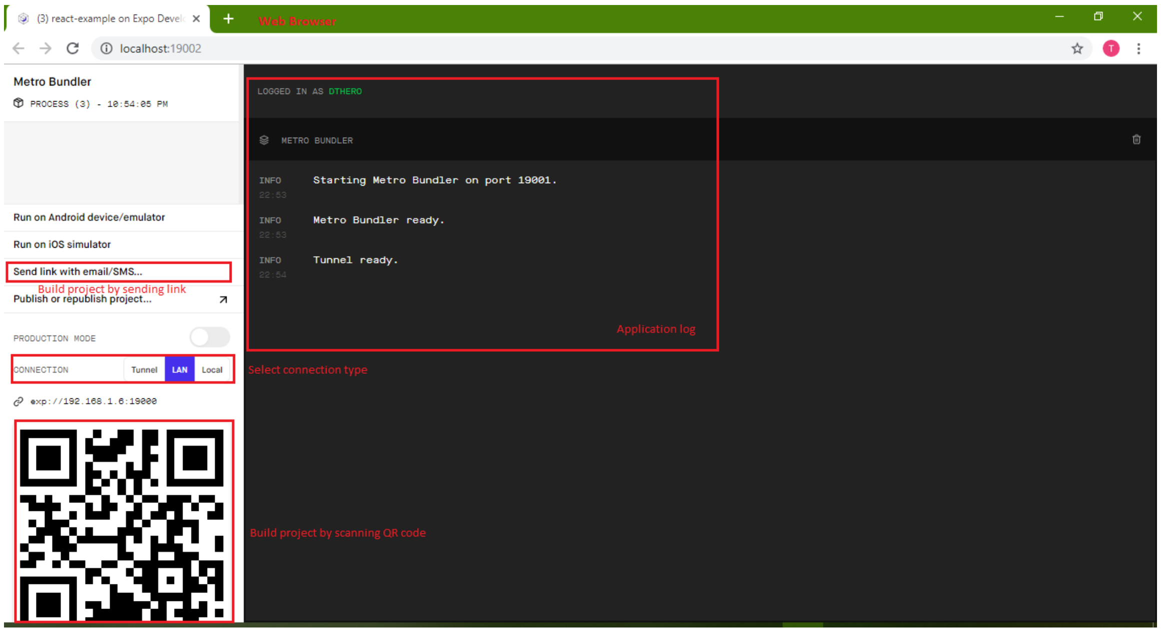
```
To run the app with live reloading, choose one of:
• Sign in as @dthero in Expo Client on Android or iOS. Your projects will automatically appear in the
  "Projects" tab.
• Scan the QR code above with the Expo app (Android) or the Camera app (iOS).
• Press a for Android emulator.
• Press e to send a link to your phone with email/SMS.
```

Figure – Expo CLI after ran start command

- A new Web Browser will show up for you with options to run project:

+ Run by the real device. In target device, install Expo client app from play store and open it, then we can build the project on the device via phone number (send build link into phone number as a message) or scan QR code on Web Browser.

+ Run by simulator. You must have a virtual device on your build environment and connect to build tool.


(3) react-example on Expo Devel
Web Browser
localhost:19002
Metro Bundler
Run on Android device/emulator
Run on iOS simulator
Send link with email/SMS...
Build project by sending link
Publish or republish project...
PRODUCTION MODE
Tunnel
LAN
Local
Application log
Select connection type
Build project by scanning QR code

```
PROCESS (3) - 10:54:05 PM
CONNECTION  LAN
exp://192.168.1.6:19000

LOGGED IN AS DTHERO

METRO BUNDLER

INFO    Starting Metro Bundler on port 19001.
22:53
INFO    Metro Bundler ready.
22:53
INFO    Tunnel ready.
22:54
```

Figure – Expo Web Browser UI

4.2. Expo log

- Writing to the logs in an Expo app works just like in the browser: use console.log, console.warn and console.error. Note: Expo does not currently support console.table outside of remote debugging mode [1].

- If you use Expo CLI, bundler logs and app logs will both automatically stream as long as your project is running. To stop your project (and end the logs stream), terminate the process with ctrl+C [2].

4.3. Why Expo

- Expo makes code project easier to deploy, maintain and execution. When you don't want to use Expo, eject your project from the Expo Client without effect to code running.

- Pros of Expo:

+ Over the air updates.

+ An easy and more reliable way of upgrading React Native versions.

+ Limitation of Android Studio/XCode configurations.

+ Certificates management with Apple or Keystores management with Google.

+ Easy to integrate with other services.

+ Sending Push Notifications.

+ Additional, easy to use modules such as Authentication Session or Blur View.

5. Open source

5.1. react-native-maps

- react-native-maps is an open source for using map view in React Native. It includes many useful component APIs to interact between user and map.

- You can integrate react-native-maps with google map by using Google API key and add it into your application.

5.2. react-native-elements

- react-native-elements is a collection of pretty component UI using in React Native such as Button, Input, Checkbox, etc. it also includes a set of complex components and makes as only one component like Rating, Search Bar, Avatar, etc.

- react-native-elements helps to make an application using React Native look more beautiful and more natural to develop complex components.

5.3. geolib

- geolib is a library developed entirely by Javascript and using calculation algorithms to estimate the result based on coordinates.

- geolib contains almost full of needed functions to get data with coordinates:

  + Calculate the distance between 2 points.
  + Get the centre point of the given list.
  + Verify that point satisfy conditions, etc.

5.4. react-native-scrollable-tab-view

- react-native-scrollable-tab-view is a library written by Javascript-only for React Native. It uses navigate functions to define a navigation pattern on iOS and Android, and it helps navigation between components and pages become easier and makes UI look more clearly, suit with modern mobile application trend.

5.5. material-ui

- material-ui is a great library/framework for developing React Js. It is a set of UI components following Google’s Material Design, including complicated component like Steppers, Date Picker, etc.

- It also integrates a huge storage of vector icons and color theme. So you can do anything with your UI component by using material-ui.

III. SYSTEM ARCHITECTURE

*** System requirements:**

- I will divide my group users into two groups:

+ User (visitor), member: Customers using my app on a smartphone.

+ Administrator, owner: The event's hosts using web UI app to manage their events.

- My project will have two parts using React:

+ First is client side for user, and it is a mobile application built on multi-platform and include main features to the user.

+ Second is server side for event's owner and administrator, it is a web UI application and contains some features help administrator can manage data and owner manage their event.

1. Use case by user-stories

1.1. user (visitor, member).

1. Display Login page to register/login

As a	visitor
I want to	See all information on Login page.
so that I can	Register new account or login to application.

2. Register new account

As a	visitor
I want to	Register new account
so that I can	Login into application.

3. Login an account

As a	user
I want to	Login to application by my account.
so that I can	Use all features of application.

4. Display homepage

As a	user
I want to	see all information of Login page when open an app on smartphone.
so that I can	login by created account or register new account for using app.

5. Navigate between tabs

As a	user
I want to	see all information of Main page whenever I logged in successfully.
so that I can	navigate between tabs and see all information of each tab.

6. Search events

As a	user
I want to	use search tool.
so that I can	search keywords of the event on News tab and Tournaments tab.

7. Display News page

As a	user
I want to	see all information of events that are approved from administrator in form of list on News Tab.
so that I can	View new event created and refresh list event.

8. Manage push notification

As a	user
I want to	Turn event's notification on or off.
so that I can	Manage all notifications that I responded.

9. Display event detail

As a	user
I want to	see detail of event.
so that I can	enroll, comment or view detail about the event.

10. Display map view

As a	user
I want to	see map view on Map tab.
so that I can	Find all events near me

11. Filter map view event by radius

As a	user
I want to	Filter map view by radius
so that I can	Find all events near me.

12. Filter map view event by sport type

As a	user
I want to	Filter map view by sport type
so that I can	Find all events near me.

13. Display personal information

As a	user
I want to	see all information of user on Personal Info tab.
so that I can	Update and view all personal information.

14. Take a photo

As a	user
I want to	Take a photo using my device’s camera.
so that I can	Update picture into application.

15. Comment on event

As a	user
I want to	Comment on specific event.
so that I can	Update my comment into event detail successfully.

16. Receive push notification

As a	user
I want to	Receive push notification from application.
so that I can	Know news about events.

17. Re-render map when location change

As a	user
I want to	Filter map by changing my current location.
so that I can	Find all events near me.

18. Change personal picture

As a	user
I want to	Take or choose a picture.
so that I can	Update my avatar into new one.

1.2. Owner, Administrator.

1. Login to web UI

As an	Owner/administrator
I want to	Login to web UI by my account
so that I can	Use all features of an event owner.

2. Register new account

As an	Owner/administrator
I want to	Register new account
so that I can	Login to web UI by created account.

3. Create new event

As an	owner
I want to	Fill all data to create new event.
so that I can	Create a new event successfully on database.

4. Remove event

As an	Owner/administrator
I want to	Remove a created event
so that I can	Delete event successfully from database.

5. Update event

As an	Owner/administrator
I want to	Update status of the event (Approved/Rejected/Pending)
so that I can	Update successfully to database.

6. Filter event by alphabet

As an	Owner/administrator
I want to	Filter list of events by alphabet
so that I can	See all events easily in Events tab.

7. Change user

As an	administrator
I want to	Add/update/remove user
so that I can	Update user successfully to database.

8. See Dashboard

As an	administrator
I want to	See all dashboard chart of events management.
so that I can	Know the information about all events in database.

2. Diagrams

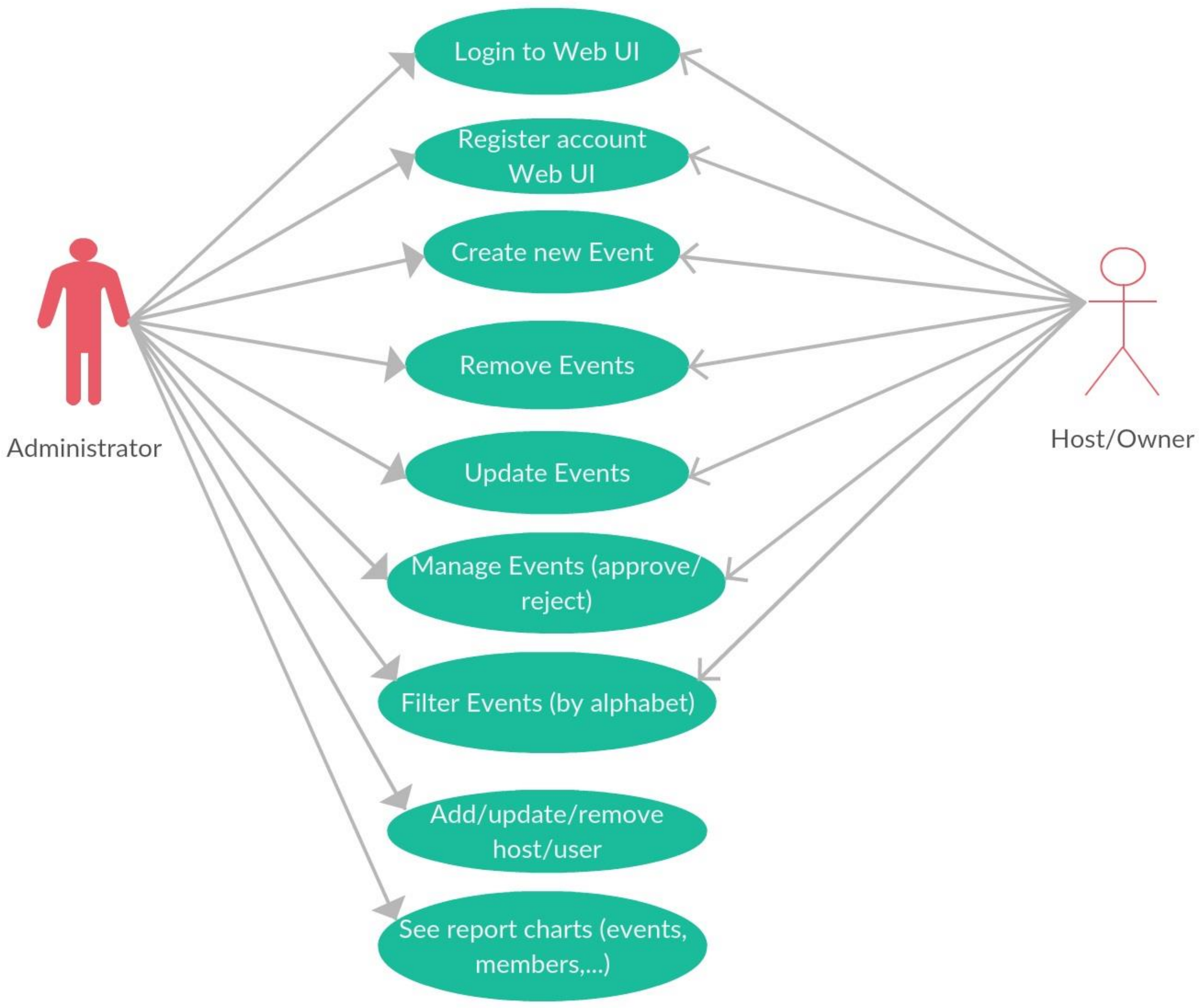

Login to Web UI
Register account Web UI
Create new Event
Remove Events
Update Events
Manage Events (approve/ reject)
Filter Events (by alphabet)
Add/update/remove host/user
See report charts (events, members,...)
Administrator
Host/Owner

Figure - Use case diagram for client

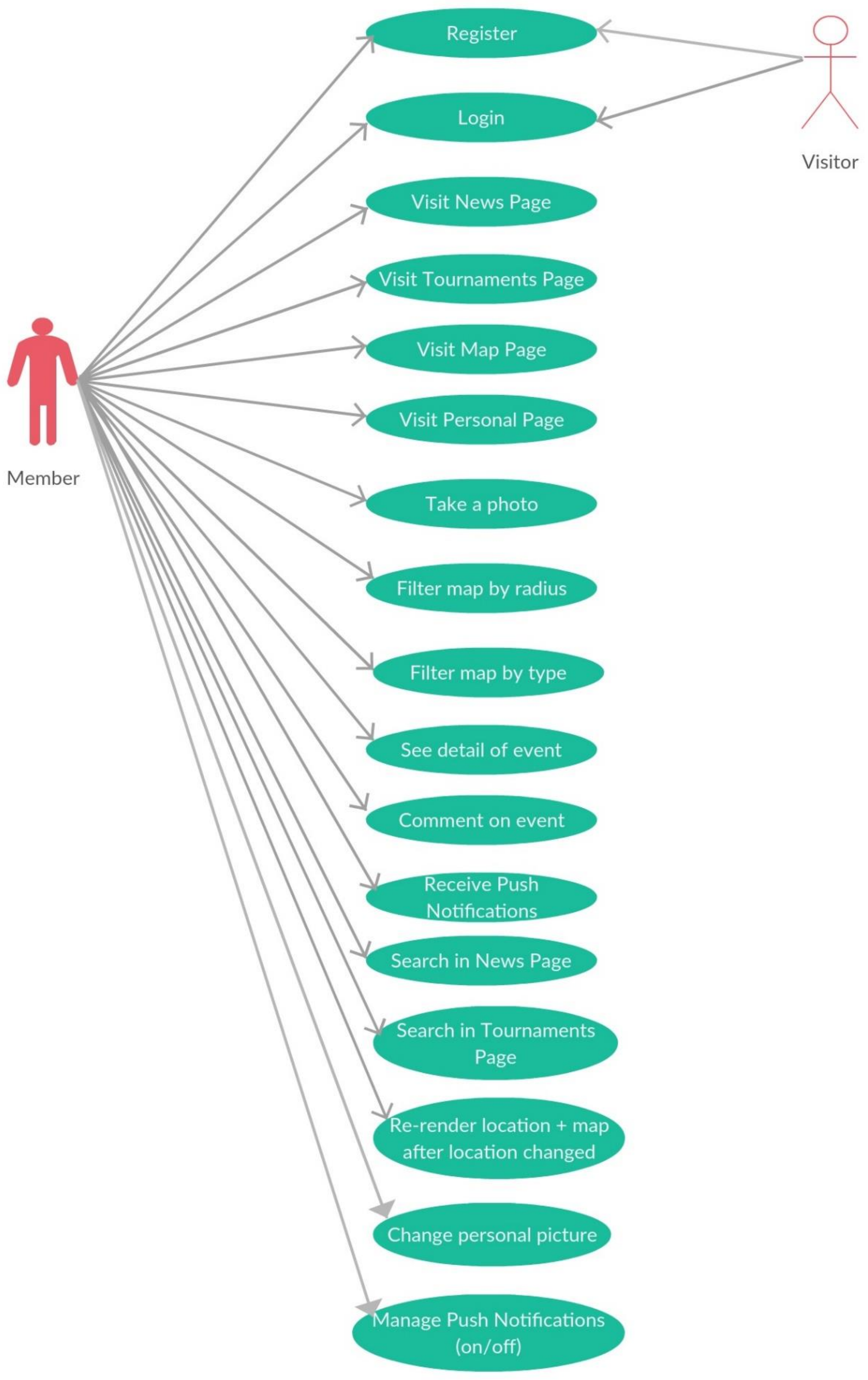


Figure - Use case diagram for server

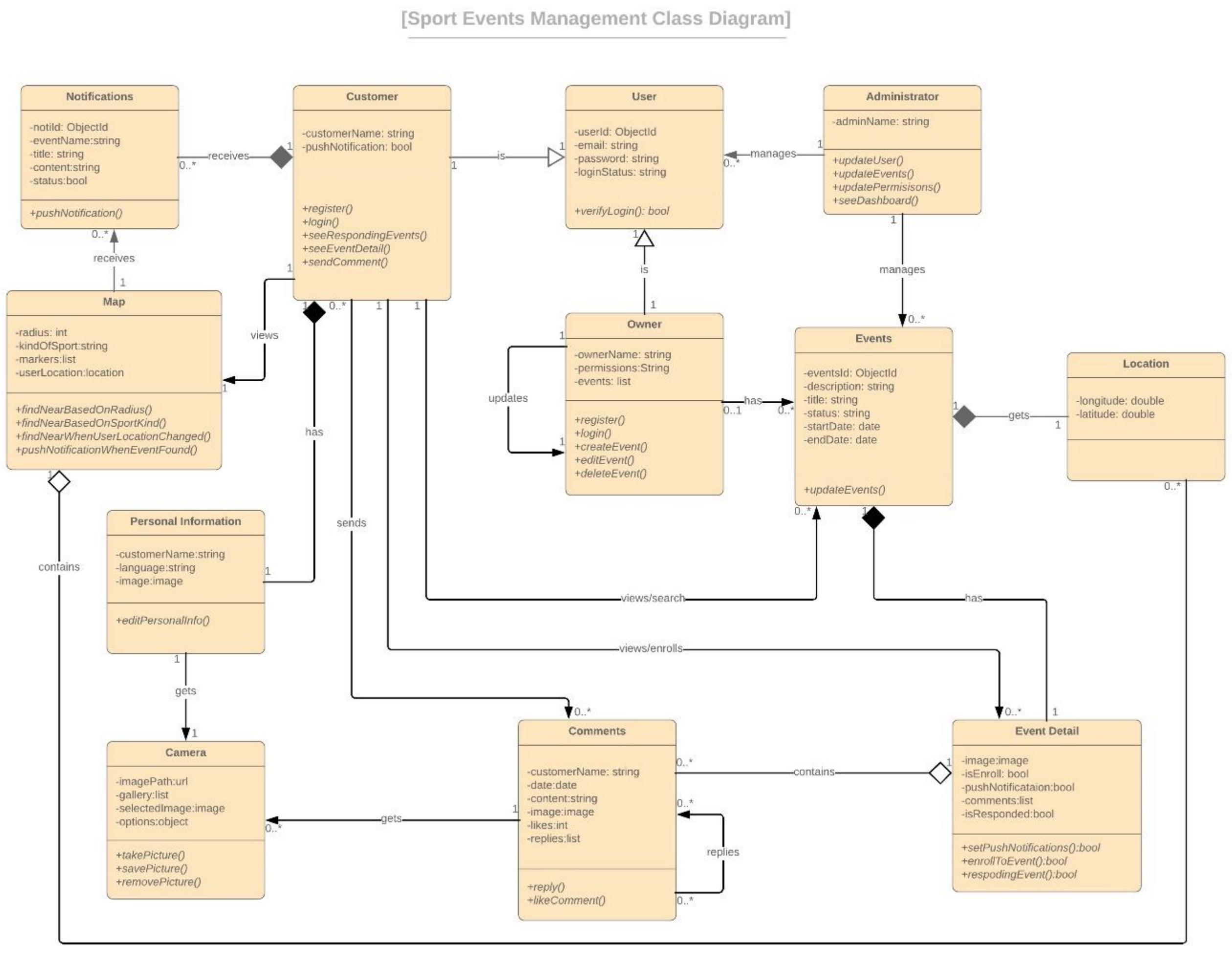


Figure - Sport Events Management Class diagram

IV. IMPLEMENTATION

* In my project, I apply technologies following these layers:

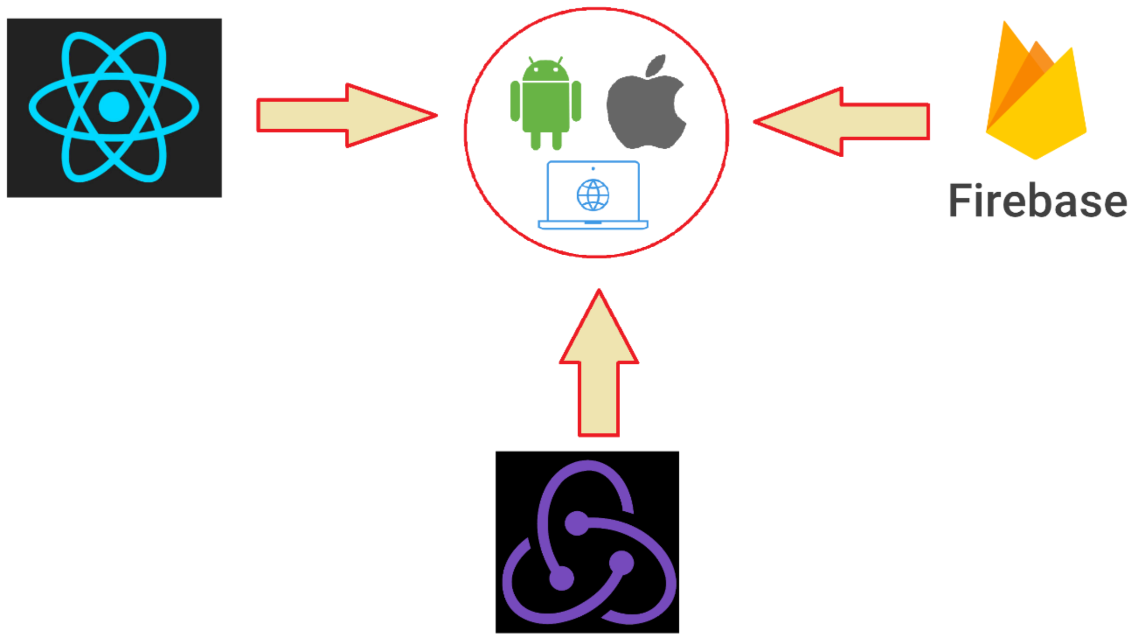


Figure – Applying technologies into project

* Go to details, we have:

- React (React Native + React JS):

+ Use to build an UI for handling view layer of single page applications (React JS for Web and React Native for Mobile).

+ Create UI components for reuse.

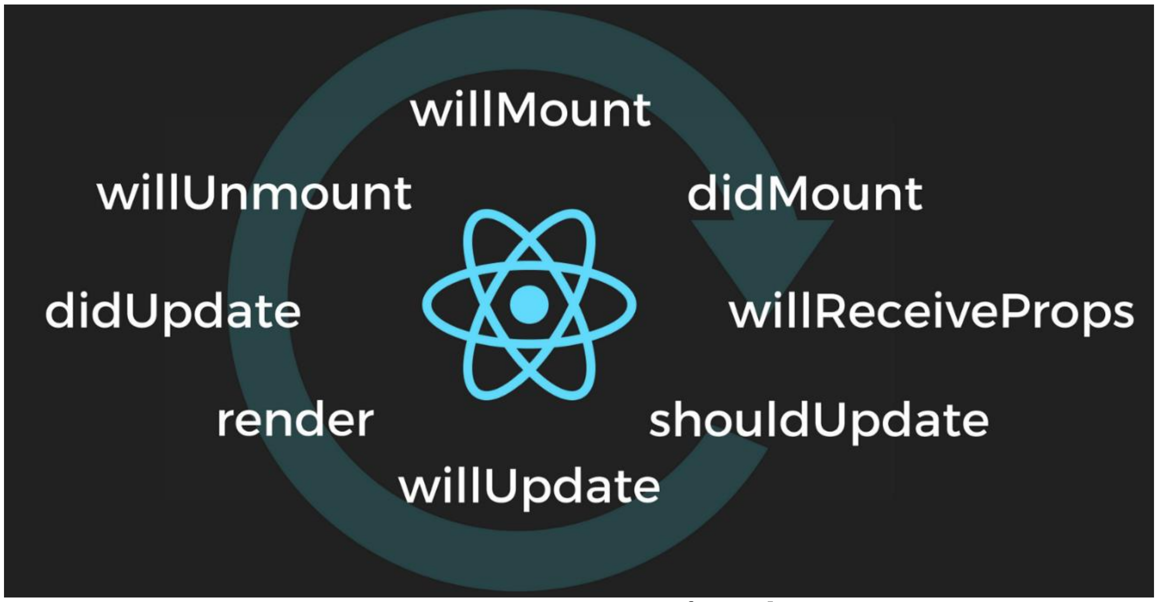


Figure - React Life Cycle

- Redux:

+ Apply Redux to control the state of application by providing "Unidirectional Data Flow" (UDF), then it helps to keep code in order and more flexible to maintain.

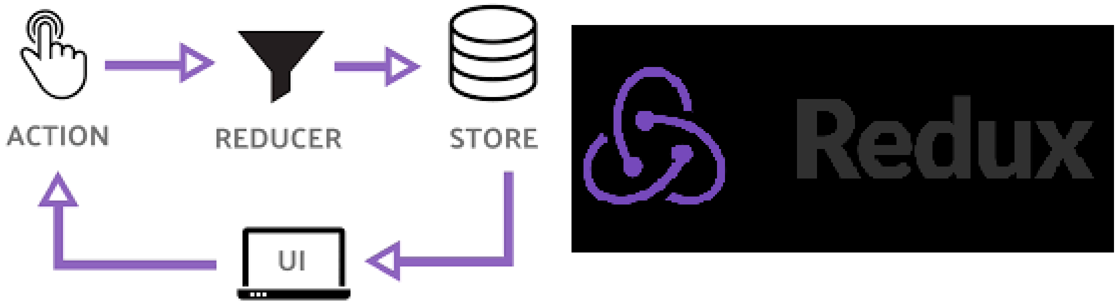


Figure - Redux Model

- Firebase:

+ To manage the backend database and trigger at the real time.

+ Integrate with various kinds of features to make application working smoothly.

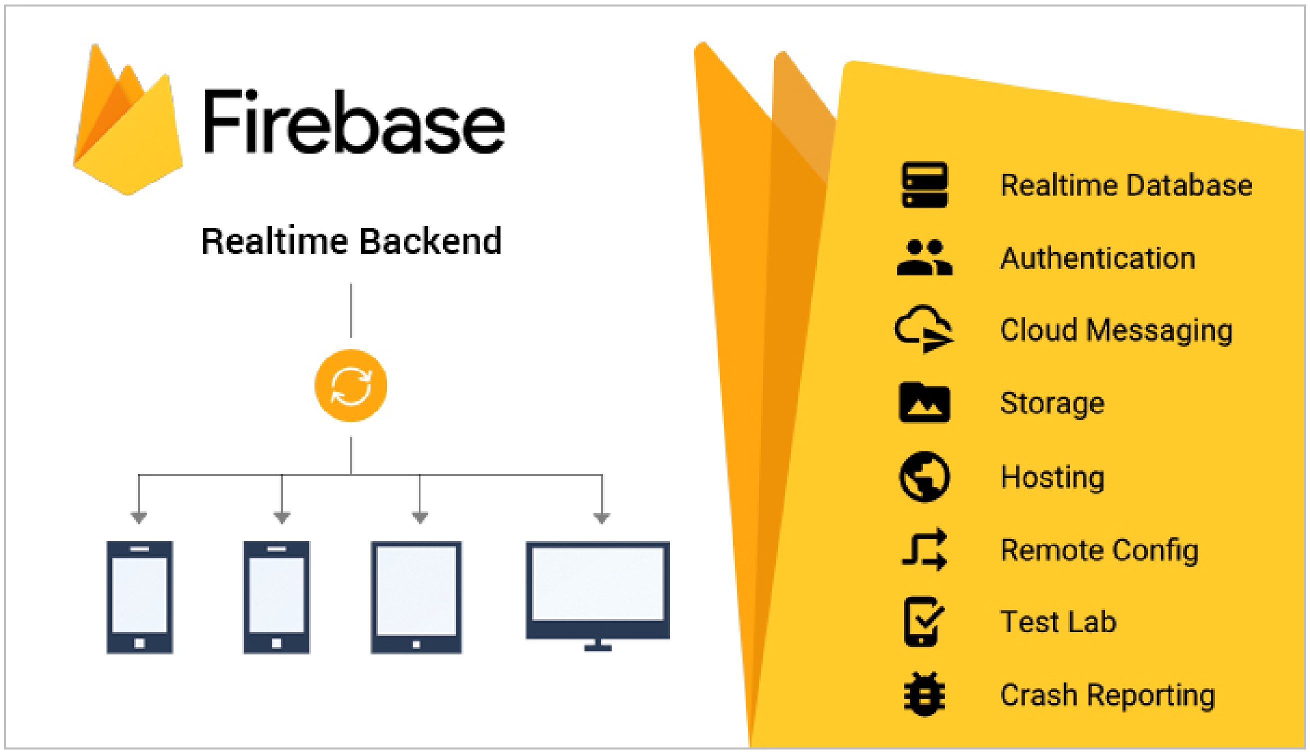


Figure – Firebase features

1. Layers, functions

1.1. Mobile Application

1.1.1. Overall structure

- List of code structures:

+ component: Reuse UI components

+ constants: Storage of constants

+ containers: Contains all UI components for using in application’s features:

Details: Event detail feature

Location: Map feature

Login: Login feature

Main: Main page, contains all other UIs.

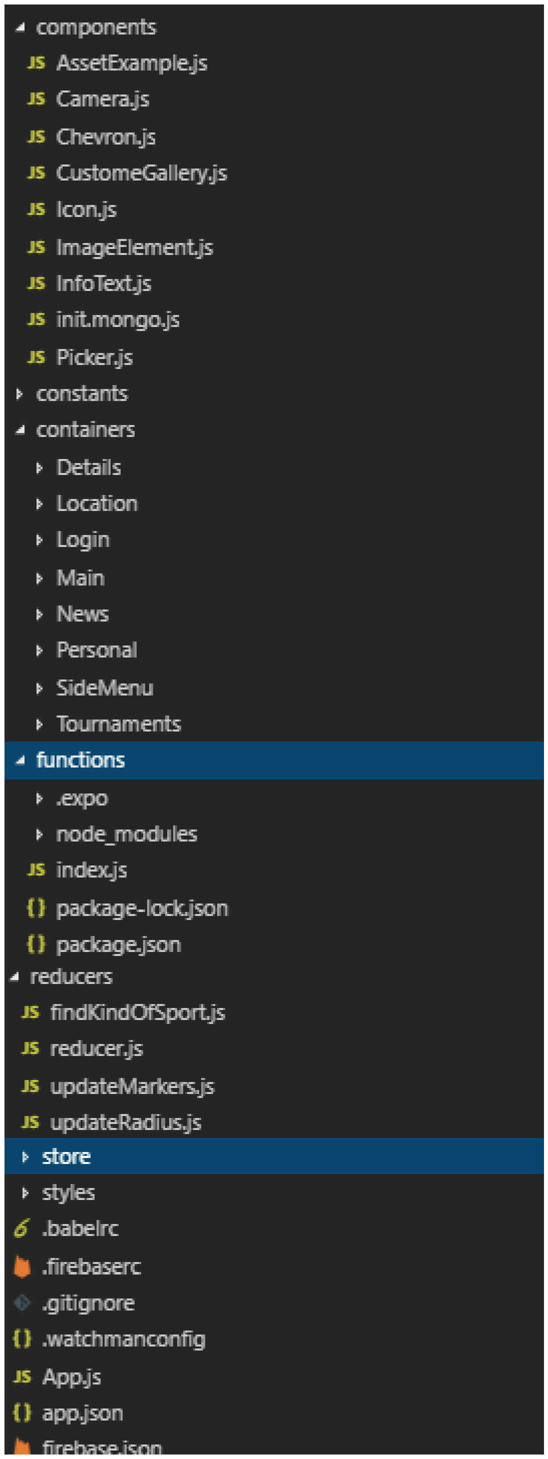
News: News feature

Personal: Personal Information feature

Tournaments: Event responding feature

+ functions: Container of Google Firebase - Cloud function

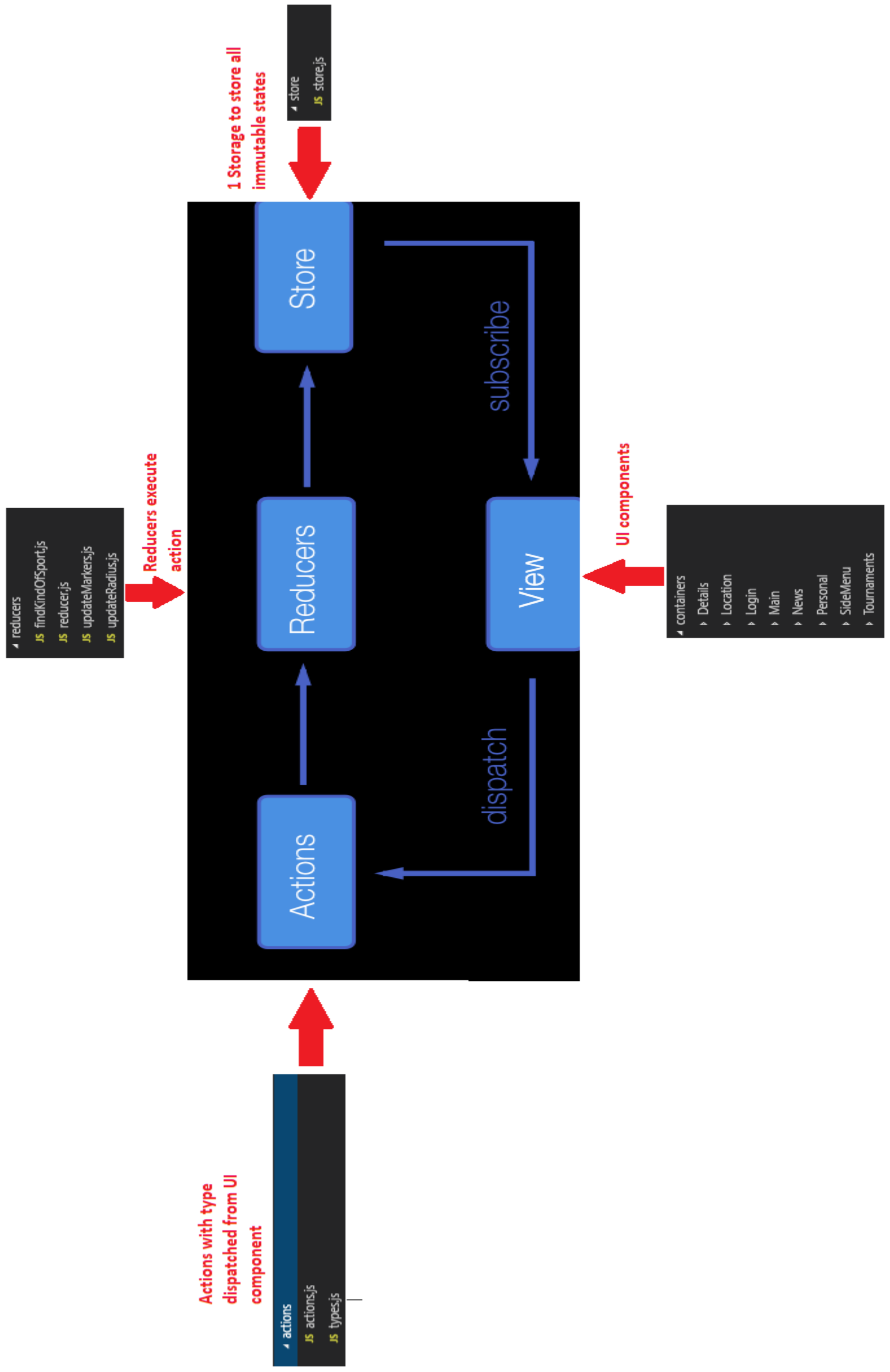
+ reducers, store: Applying of Redux into project



```
components
  AssetExample.js
  Camera.js
  Chevron.js
  CustomeGallery.js
  Icon.js
  ImageElement.js
  InfoText.js
  init.mongo.js
  Picker.js
constants
containers
  Details
  Location
  Login
  Main
  News
  Personal
  SideMenu
  Tournaments
functions
  .expo
  node_modules
  index.js
  package-lock.json
  package.json
reducers
  findKindOfSport.js
  reducer.js
  updateMarkers.js
  updateRadius.js
store
styles
.babelrc
.firebaserc
.gitignore
.watchmanconfig
App.js
app.json
firebase.json
```

Figure - Code structure

- Mapping between packages and Redux:



1.1.2. Push Notification

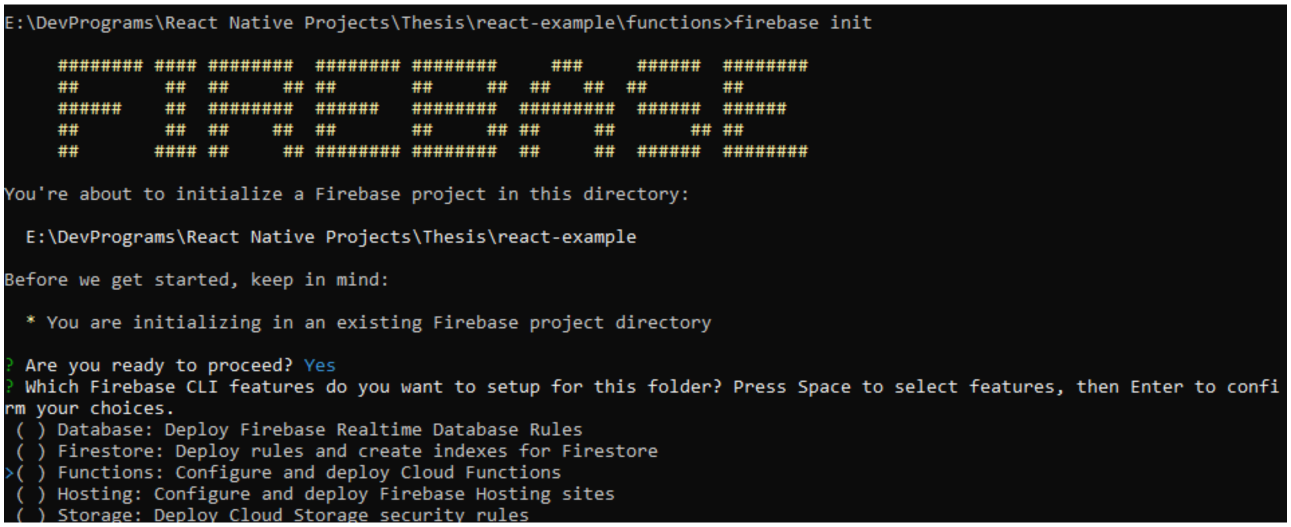
- My application using Cloud Function integrate with Expo to send Push Notification at the real time to devices.

- To initialize Cloud Function in application, try following steps:

+ Initialize Firebase in product path:

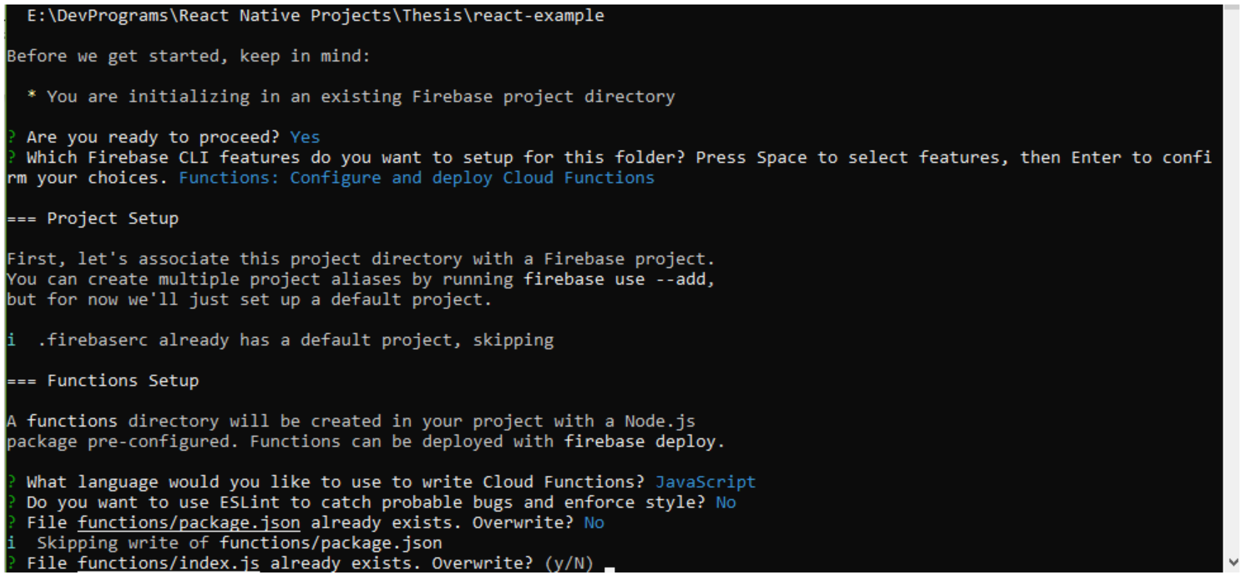
```
firebase init
```

+ Type “Y” and select “Functions”



```
E:\DevPrograms\React Native Projects\Thesis\react-example\functions>firebase init

     ######## #### ########  ######## ########     ###     ######  ########
     ##        ##  ##     ## ##       ##     ##  ##   ##  ##       ##
     ######    ##  ########  ######   ########  #########  ######  ######
     ##        ##  ##    ##  ##       ##     ## ##     ##       ## ##
     ##       #### ##     ## ######## ######## ##     ##  ######  ########

You're about to initialize a Firebase project in this directory:

  E:\DevPrograms\React Native Projects\Thesis\react-example

Before we get started, keep in mind:

  * You are initializing in an existing Firebase project directory

? Are you ready to proceed? Yes
? Which Firebase CLI features do you want to setup for this folder? Press Space to select features, then Enter to confi
rm your choices.
 ( ) Database: Deploy Firebase Realtime Database Rules
 ( ) Firestore: Deploy rules and create indexes for Firestore
>( ) Functions: Configure and deploy Cloud Functions
 ( ) Hosting: Configure and deploy Firebase Hosting sites
 ( ) Storage: Deploy Cloud Storage security rules
```

+ Select language to write function, then choose the other suitable options with you (in case of mine, I have already do the function before then I choose “N” all)



```
 E:\DevPrograms\React Native Projects\Thesis\react-example

Before we get started, keep in mind:

  * You are initializing in an existing Firebase project directory

? Are you ready to proceed? Yes
? Which Firebase CLI features do you want to setup for this folder? Press Space to select features, then Enter to confi
rm your choices. Functions: Configure and deploy Cloud Functions

=== Project Setup

First, let's associate this project directory with a Firebase project.
You can create multiple project aliases by running firebase use --add,
but for now we'll just set up a default project.

i  .firebaserc already has a default project, skipping

=== Functions Setup

A functions directory will be created in your project with a Node.js
package pre-configured. Functions can be deployed with firebase deploy.

? What language would you like to use to write Cloud Functions? JavaScript
? Do you want to use ESLint to catch probable bugs and enforce style? No
? File functions/package.json already exists. Overwrite? No
i  Skipping write of functions/package.json
? File functions/index.js already exists. Overwrite? (y/N)
```

+ When select all options and execute, firebase will initialize successfully and show a file name Index.js inside created package "functions"

- Next, access to "functions" package and run command to install needed module:

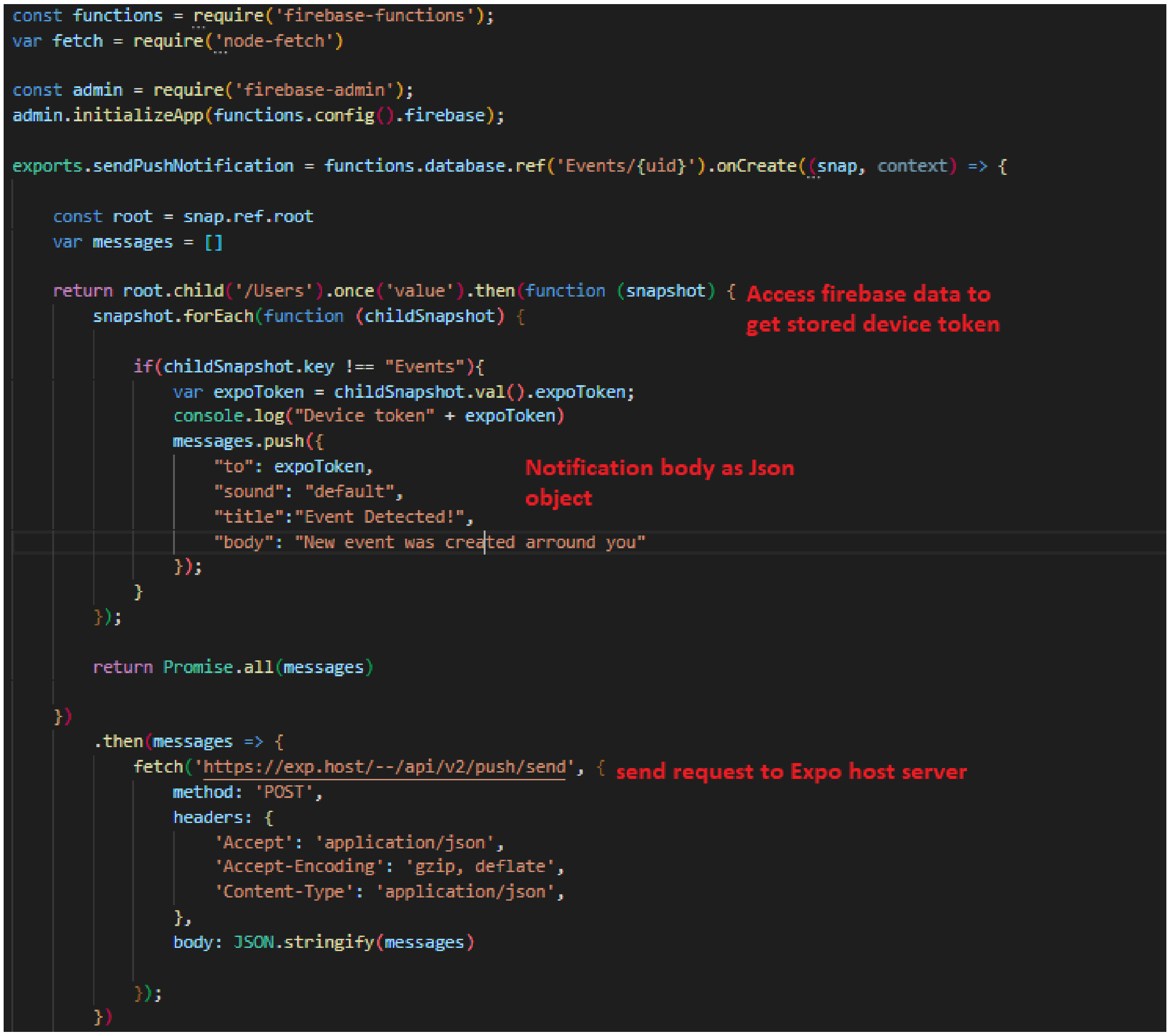
```
npm install node-fetch
```

- Define your function in "Index.js" file and run command to deploy function on Firebase server:

```
firebase deploy
```

- Function deployed successfully will show with message "complete".

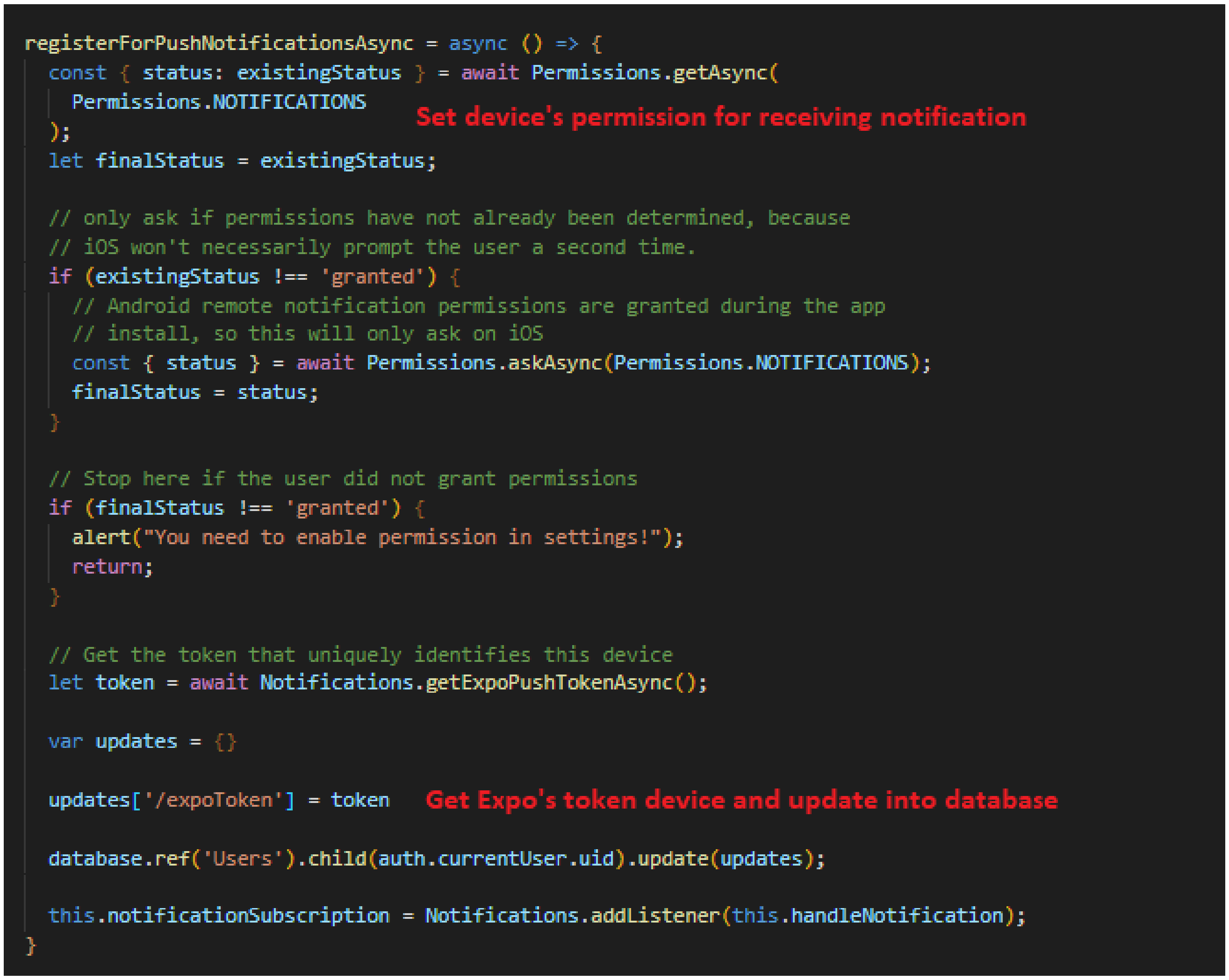
- To receive notification, you must register your device's token and there is how your device integrate with Firebase from UI component:



```
const functions = require('firebase-functions');
var fetch = require('node-fetch')

const admin = require('firebase-admin');
admin.initializeApp(functions.config().firebase);

exports.sendPushNotification = functions.database.ref('Events/{uid}').onCreate((snap, context) => {

    const root = snap.ref.root
    var messages = []

    return root.child('/Users').once('value').then(function (snapshot) {
        snapshot.forEach(function (childSnapshot) {

            if(childSnapshot.key !== "Events"){
                var expoToken = childSnapshot.val().expoToken;
                console.log("Device token" + expoToken)
                messages.push({
                    "to": expoToken,
                    "sound": "default",
                    "title":"Event Detected!",
                    "body": "New event was created arround you"
                });
            }
        });

        return Promise.all(messages)

    })
        .then(messages => {
            fetch('https://exp.host/--/api/v2/push/send', {
                method: 'POST',
                headers: {
                    'Accept': 'application/json',
                    'Accept-Encoding': 'gzip, deflate',
                    'Content-Type': 'application/json',
                },
                body: JSON.stringify(messages)

            });
        })
```

Access firebase data to get stored device token
Notification body as Json object
send request to Expo host server

Figure - Write function to send Push Notification in “Index.js”



```
registerForPushNotificationsAsync = async () => {
  const { status: existingStatus } = await Permissions.getAsync(
    Permissions.NOTIFICATIONS
  );
  let finalStatus = existingStatus;

  // only ask if permissions have not already been determined, because
  // iOS won't necessarily prompt the user a second time.
  if (existingStatus !== 'granted') {
    // Android remote notification permissions are granted during the app
    // install, so this will only ask on iOS
    const { status } = await Permissions.askAsync(Permissions.NOTIFICATIONS);
    finalStatus = status;
  }

  // Stop here if the user did not grant permissions
  if (finalStatus !== 'granted') {
    alert("You need to enable permission in settings!");
    return;
  }

  // Get the token that uniquely identifies this device
  let token = await Notifications.getExpoPushTokenAsync();

  var updates = {}

  updates['/expoToken'] = token

  database.ref('Users').child(auth.currentUser.uid).update(updates);

  this.notificationSubscription = Notifications.addListener(this.handleNotification);
}
```

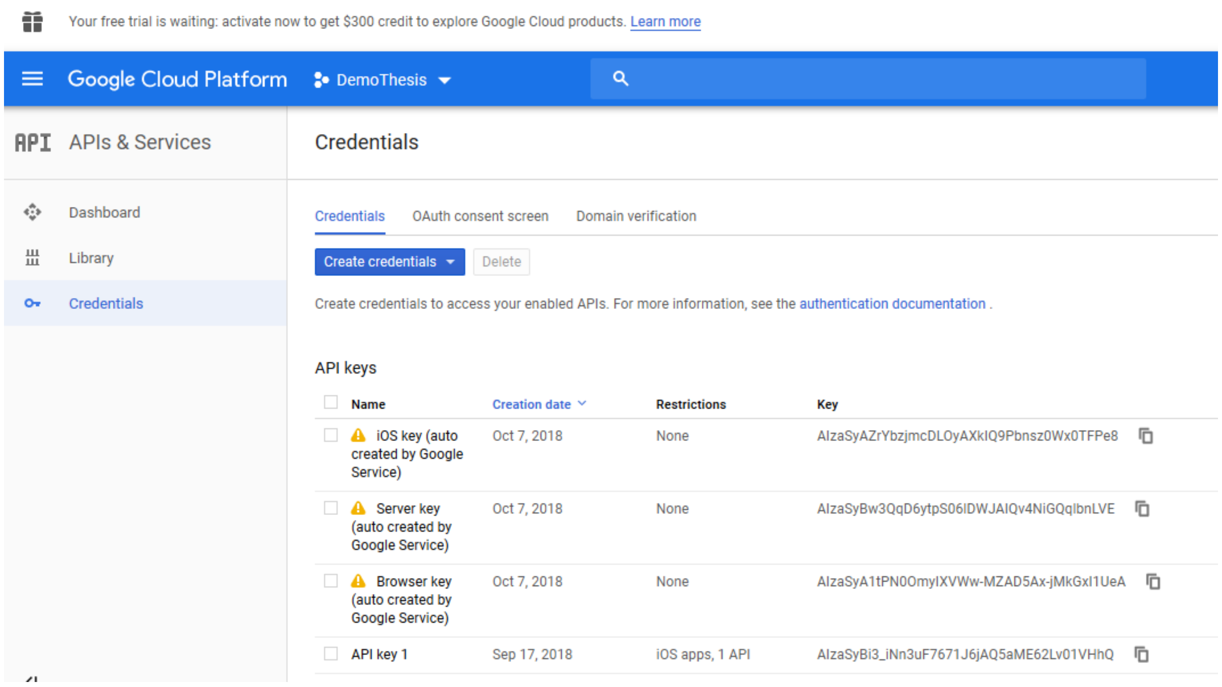
Set device's permission for receiving notification
Get Expo's token device and update into database

Figure - Register device's token and update to database to receive notification in UI component

1.1.3. Map View

- Map view in my application use “react-native-map” module integrated by Expo and Google Map API.

- First, get Google API by accessing https://console.cloud.google.com and register one, the API maybe provided for only mobile platform (iOS or Android) or for general purpose.



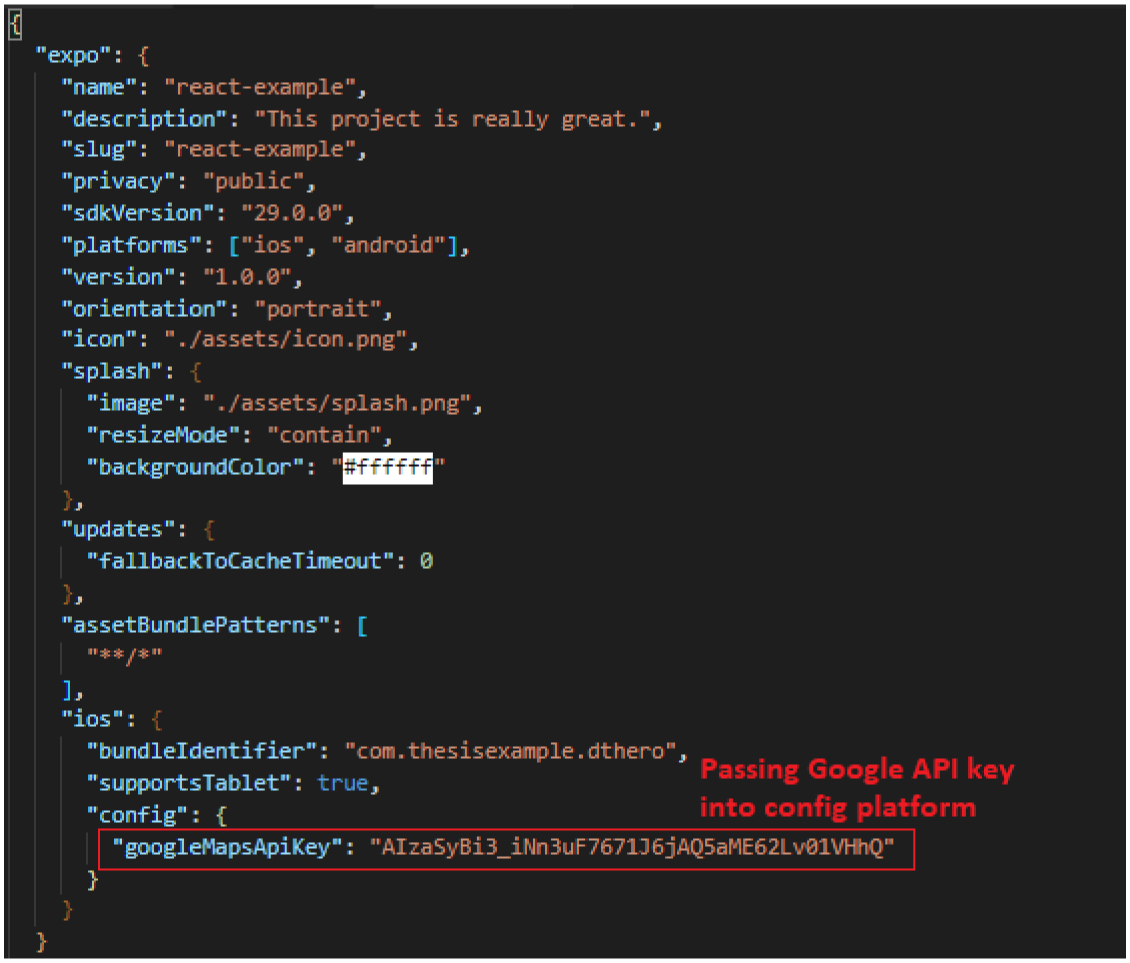
Create credentials to access your enabled APIs. For more information, see the authentication documentation .

API keys

Name	Creation date	Restrictions	Key
iOS key (auto created by Google Service)	Oct 7, 2018	None	AIzaSyAZrYbzjmcDLOyAXkIQ9Pbnsz0Wx0TFPe8
Server key (auto created by Google Service)	Oct 7, 2018	None	AIzaSyBw3QqD6ytpS06IDWJAIQv4NiGQqlbnLVE
Browser key (auto created by Google Service)	Oct 7, 2018	None	AIzaSyA1tPN0OmyIXVWw-MZAD5Ax-jMkGxI1UeA
API key 1	Sep 17, 2018	iOS apps, 1 API	AIzaSyBi3_iNn3uF7671J6jAQ5aME62Lv01VHhQ

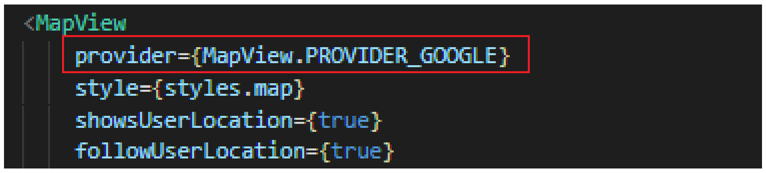
Figure – Google Cloud console of managing API keys

- To use Google Map in Map View, register it by passing API key into config file of project (in this case is Expo’s app.json file):



```
{
  "expo": {
    "name": "react-example",
    "description": "This project is really great.",
    "slug": "react-example",
    "privacy": "public",
    "sdkVersion": "29.0.0",
    "platforms": ["ios", "android"],
    "version": "1.0.0",
    "orientation": "portrait",
    "icon": "./assets/icon.png",
    "splash": {
      "image": "./assets/splash.png",
      "resizeMode": "contain",
      "backgroundColor": "#ffffff"
    },
    "updates": {
      "fallbackToCacheTimeout": 0
    },
    "assetBundlePatterns": [
      "**/*"
    ],
    "ios": {
      "bundleIdentifier": "com.thesisexample.dthero",
      "supportsTablet": true,
      "config": {
        "googleMapsApiKey": "AIzaSyBi3_iNn3uF7671J6jAQ5aME62Lv01VHhQ"
      }
    }
  }
}
```

- Then pass prop of Map View component by Google as provider



```
<MapView
    provider={MapView.PROVIDER_GOOGLE}
    style={styles.map}
    showsUserLocation={true}
    followUserLocation={true}
```

1.1.4. Camera

- Camera is a reuse component (using in both Event Detail and Personal Information features) so we must put it in "components" package

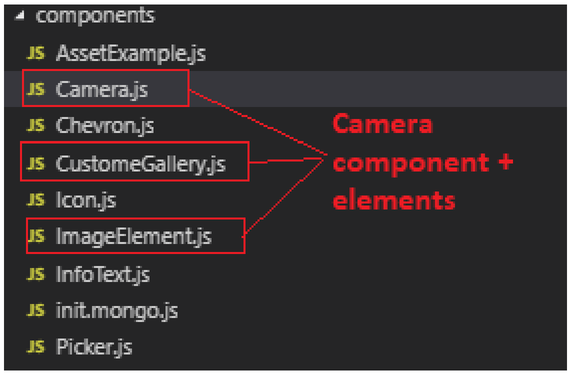
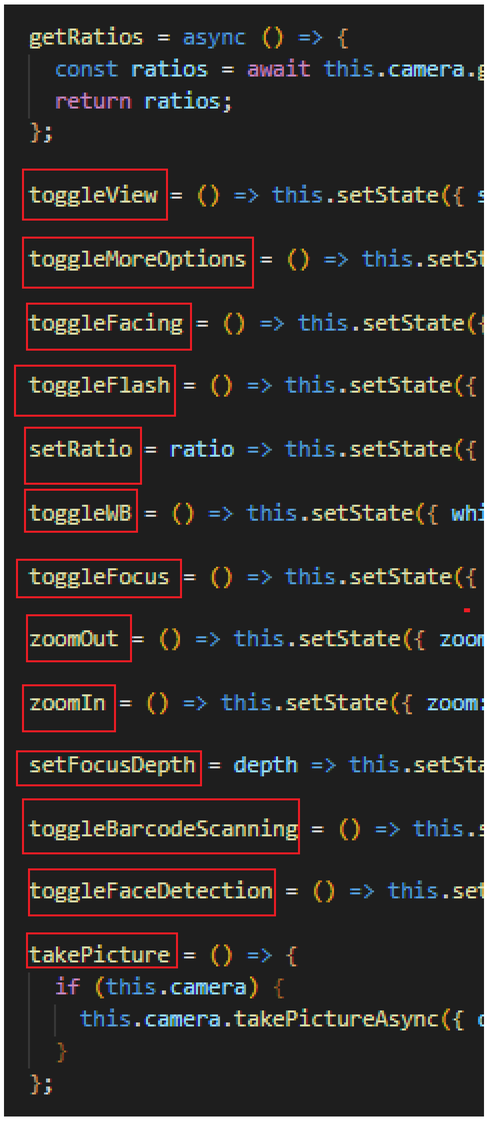
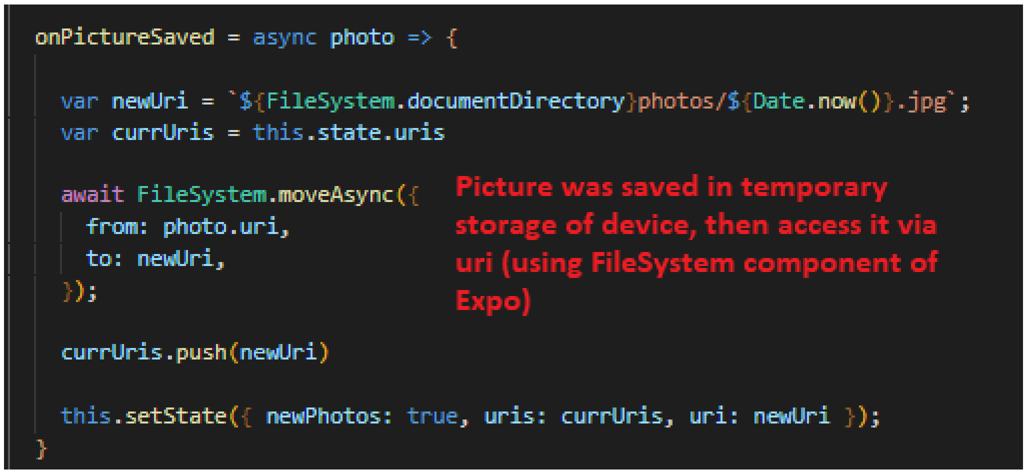


Figure - Camera component



```
getRatios = async () => {
  const ratios = await this.camera.g
  return ratios;
};

toggleView = () => this.setState({ s

toggleMoreOptions = () => this.setSt

toggleFacing = () => this.setState({

toggleFlash = () => this.setState({

setRatio = ratio => this.setState({

toggleWB = () => this.setState({ whi

toggleFocus = () => this.setState({

zoomOut = () => this.setState({ zoom

zoomIn = () => this.setState({ zoom:

setFocusDepth = depth => this.setSta

toggleBarcodeScanning = () => this.s

toggleFaceDetection = () => this.set

takePicture = () => {
  if (this.camera) {
    this.camera.takePictureAsync({ c
  }
};
```

Figure - Actions inside Camera component



```
onPictureSaved = async photo => {

  var newUri = `${FileSystem.documentDirectory}photos/${Date.now()}.jpg`;
  var currUris = this.state.uris

  await FileSystem.moveAsync({
    from: photo.uri,
    to: newUri,
  });

  currUris.push(newUri)

  this.setState({ newPhotos: true, uris: currUris, uri: newUri });
}
```

Picture was saved in temporary storage of device, then access it via uri (using FileSystem component of Expo)

1.2. Web application

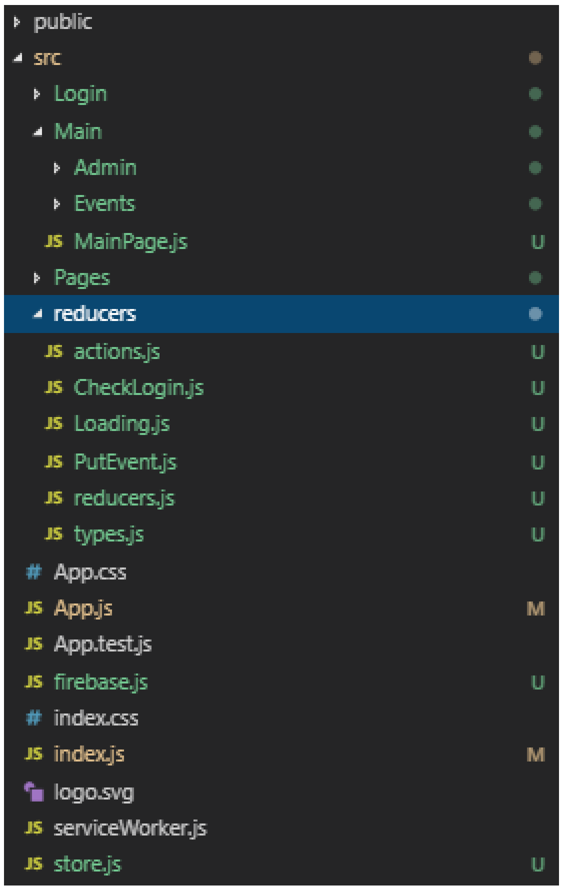
1.2.1. Overall Structure

- List of features:

+ Login: Login feature

+ Main: Includes Main page and child component (Admin feature + Events feature)

- reducers: Applying of Redux into project

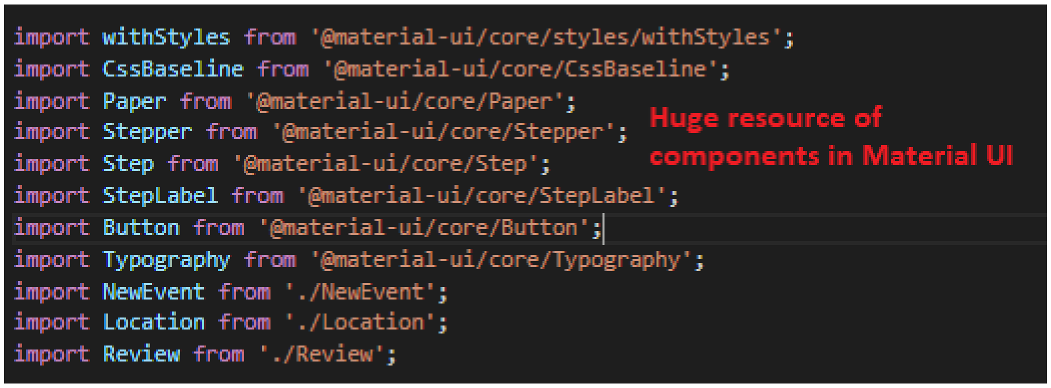


```
▸ public
◂ src
  ▸ Login
  ◂ Main
    ▸ Admin
    ▸ Events
    JS MainPage.js        U
  ▸ Pages
  ◂ reducers
    JS actions.js         U
    JS CheckLogin.js      U
    JS Loading.js         U
    JS PutEvent.js        U
    JS reducers.js        U
    JS types.js           U
  # App.css
  JS App.js               M
  JS App.test.js
  JS firebase.js          U
  # index.css
  JS index.js             M
  logo.svg
  JS serviceWorker.js
  JS store.js             U
```

Figure – Web application code structure

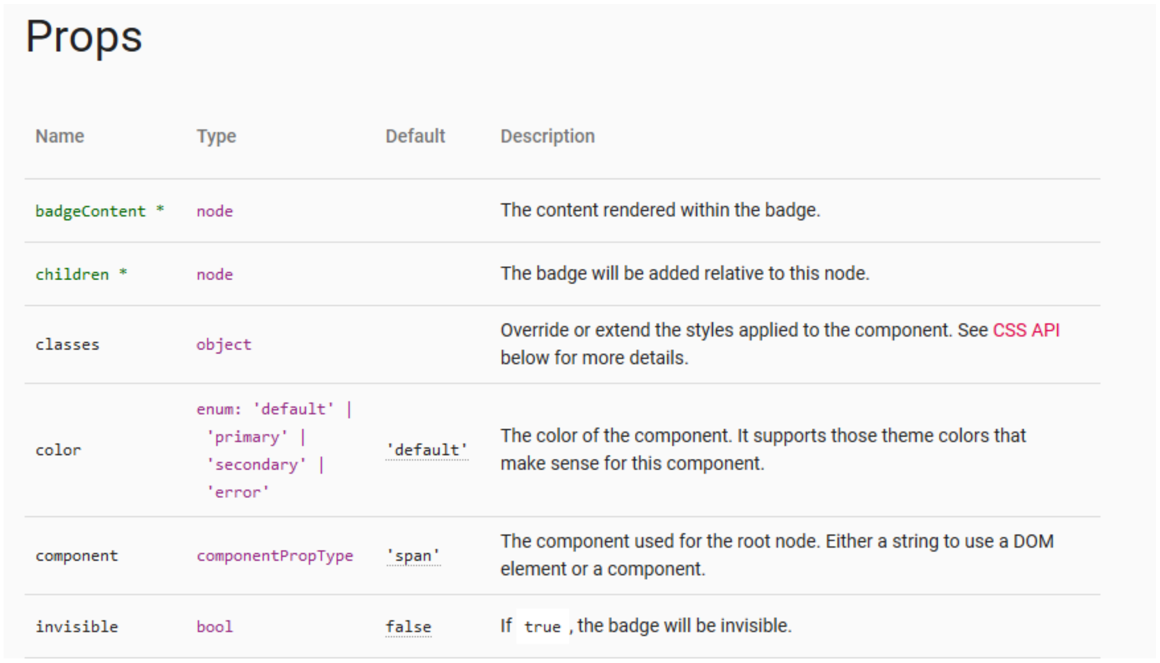
1.2.2. UI component - Material UI

- Material UI is a great UI framework for developing React JS, with almost full of necessary components for a single page application.



```
import withStyles from '@material-ui/core/styles/withStyles';
import CssBaseline from '@material-ui/core/CssBaseline';
import Paper from '@material-ui/core/Paper';
import Stepper from '@material-ui/core/Stepper';
import Step from '@material-ui/core/Step';
import StepLabel from '@material-ui/core/StepLabel';
import Button from '@material-ui/core/Button';
import Typography from '@material-ui/core/Typography';
import NewEvent from './NewEvent';
import Location from './Location';
import Review from './Review';
```

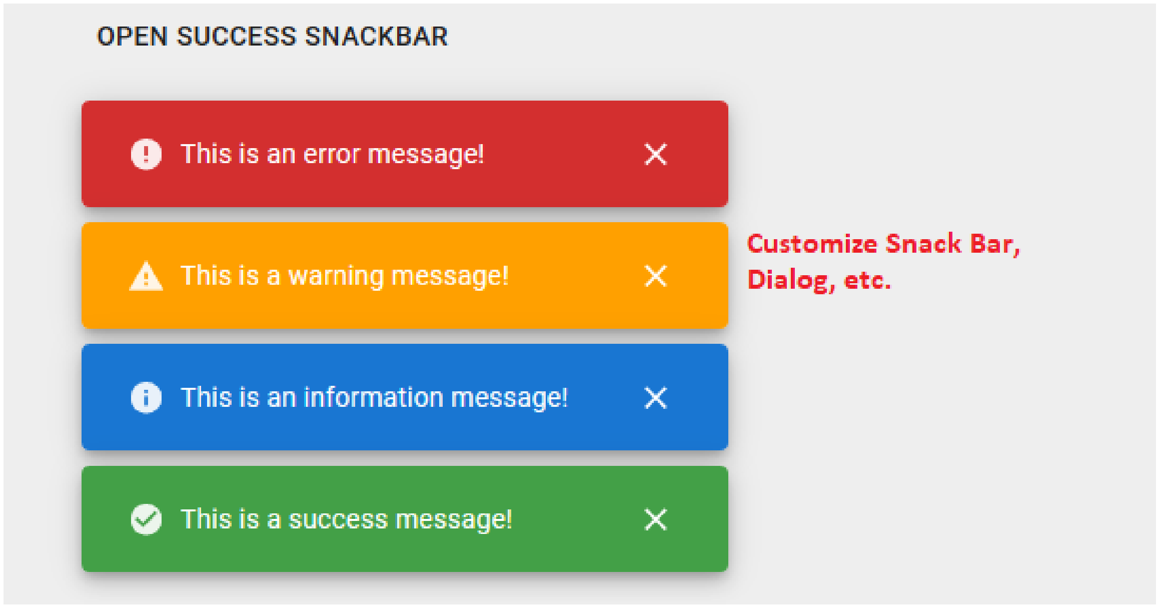
- It also provides many props relates and need for 1 component



Props

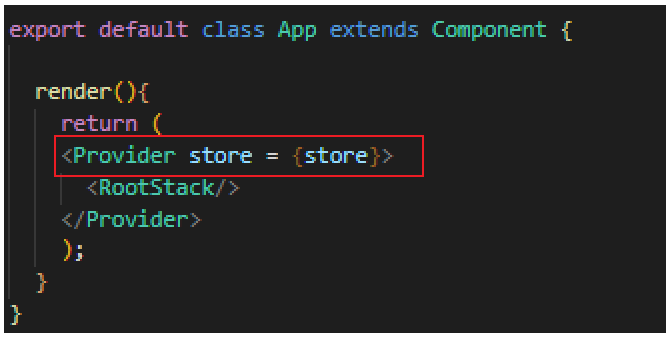
Name	Type	Default	Description
badgeContent *	node		The content rendered within the badge.
children *	node		The badge will be added relative to this node.
classes	object		Override or extend the styles applied to the component. See CSS API below for more details.
color	enum: 'default' | 'primary' | 'secondary' | 'error'	'default'	The color of the component. It supports those theme colors that make sense for this component.
component	componentPropType	'span'	The component used for the root node. Either a string to use a DOM element or a component.
invisible	bool	false	If true , the badge will be invisible.

- Create a complex component to become more straightforward and customizable


OPEN SUCCESS SNACKBAR
This is an error message!
This is a warning message!
This is an information message!
This is a success message!
Customize Snack Bar, Dialog, etc.

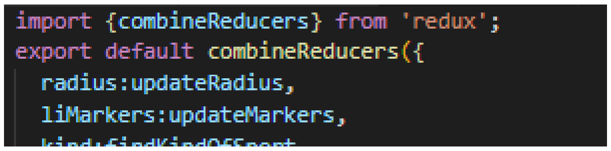
1.3. Redux implementation – react-redux

- Define Redux at root component by providing Store class:

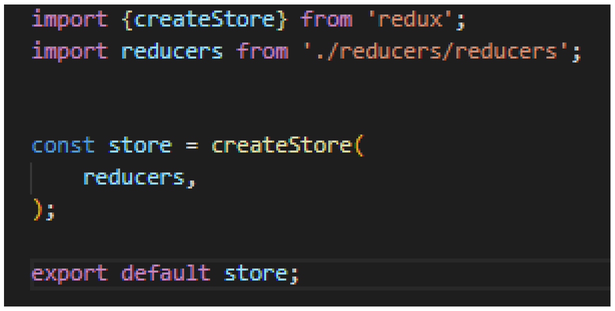


```
export default class App extends Component {

  render(){
    return (
    <Provider store = {store}>
      <RootStack/>
    </Provider>
    );
  }
}
```

- Combine multi-reducers into only 1 and passing to Store:

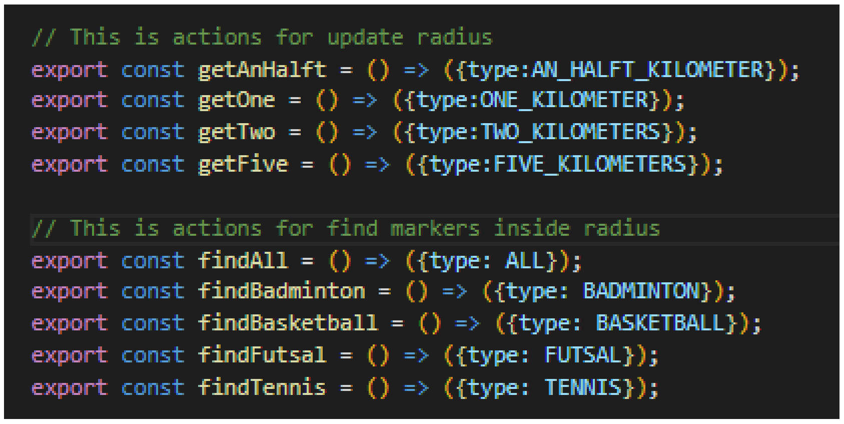


```
import {combineReducers} from 'redux';
export default combineReducers({
  radius:updateRadius,
  liMarkers:updateMarkers,
```



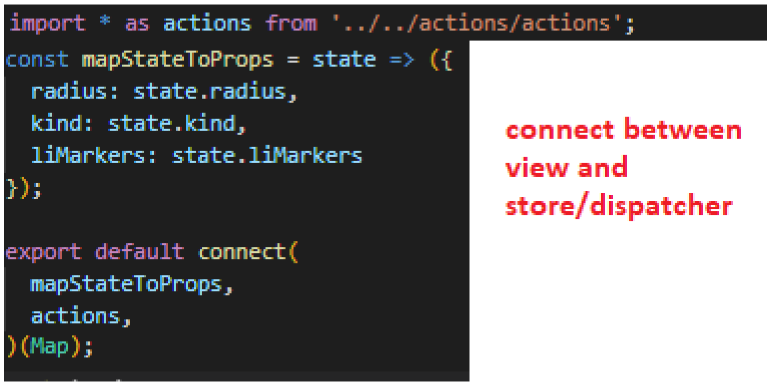
```
import {createStore} from 'redux';
import reducers from './reducers/reducers';


const store = createStore(
    reducers,
);

export default store;
```

- Initialize actions as callback functions for reducers:



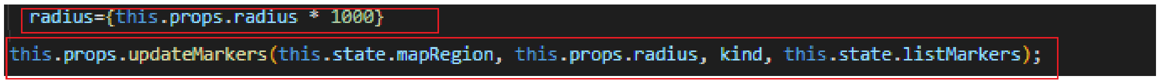
```
// This is actions for update radius
export const getAnHalft = () => ({type:AN_HALFT_KILOMETER});
export const getOne = () => ({type:ONE_KILOMETER});
export const getTwo = () => ({type:TWO_KILOMETERS});
export const getFive = () => ({type:FIVE_KILOMETERS});

// This is actions for find markers inside radius
export const findAll = () => ({type: ALL});
export const findBadminton = () => ({type: BADMINTON});
export const findBasketball = () => ({type: BASKETBALL});
export const findFutsal = () => ({type: FUTSAL});
export const findTennis = () => ({type: TENNIS});
```

- To trigger an action from component or update data from Store to View, we need to use connect() function in react-redux. Define all return states of Store as component's props and import action, then pass it all to connect() function to initialize connection between component and states.



```
import * as actions from '../../actions/actions';
const mapStateToProps = state => ({
  radius: state.radius,
  kind: state.kind,
  liMarkers: state.liMarkers
});

export default connect(
  mapStateToProps,
  actions,
)(Map);
```

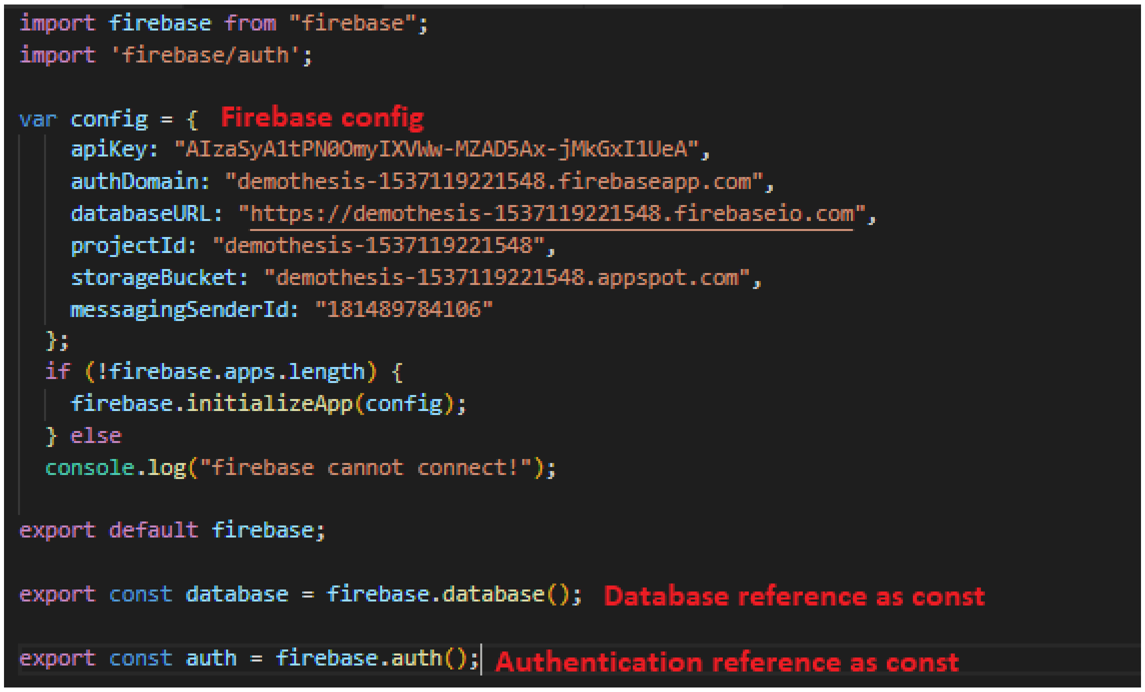
- After apply Redux into component, calling actions or getting latest state by using "this.props"



```
radius={this.props.radius * 1000}
this.props.updateMarkers(this.state.mapRegion, this.props.radius, kind, this.state.listMarkers);
```

1.4. Firebase - Realtime Database

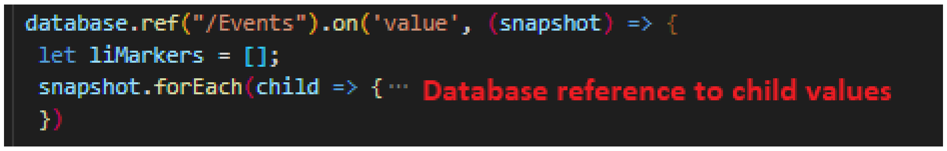
- To use Firebase database in the project, we must config our mapping project on Firebase console and call it when trigger data, since Firebase config is unchanged, so I saved "firebase.js" config file in "constants" package:



```
import firebase from "firebase";
import 'firebase/auth';

var config = {  Firebase config
    apiKey: "AIzaSyA1tPN0OmyIXVWw-MZAD5Ax-jMkGxI1UeA",
    authDomain: "demothesis-1537119221548.firebaseapp.com",
    databaseURL: "https://demothesis-1537119221548.firebaseio.com",
    projectId: "demothesis-1537119221548",
    storageBucket: "demothesis-1537119221548.appspot.com",
    messagingSenderId: "181489784106"
  };
  if (!firebase.apps.length) {
    firebase.initializeApp(config);
  } else
  console.log("firebase cannot connect!");

export default firebase;

export const database = firebase.database();  Database reference as const

export const auth = firebase.auth();  Authentication reference as const
```

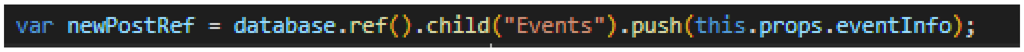
Figure - Firebase config and constant references

- To trigger data from server, using const above and access to desired child

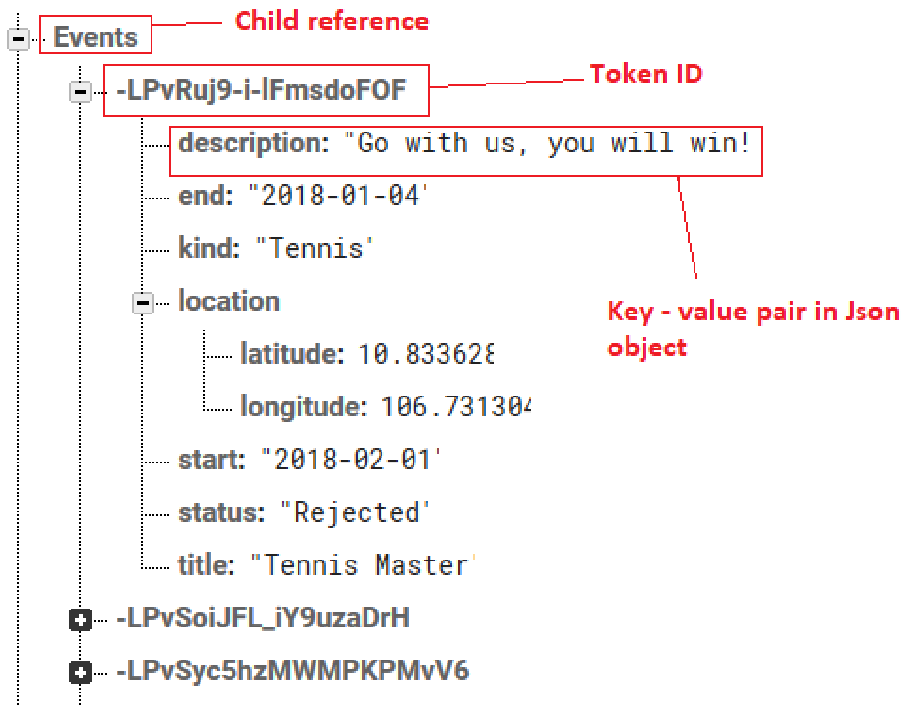


```
database.ref("/Events").on('value', (snapshot) => {
  let liMarkers = [];
  snapshot.forEach(child => {⋯  Database reference to child values
  })
```

- Firebase Realtime Database is save as Json object and include Token ID (the same as Object ID) in MongoDB. Each time we push new data into database, we can generate new Token ID data object:

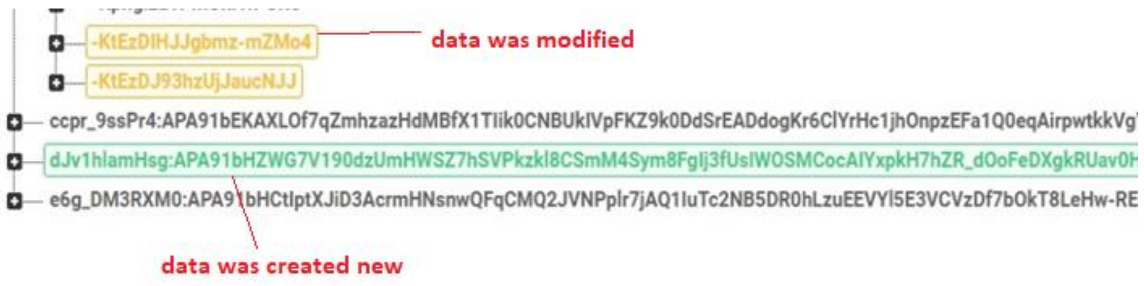


```
var newPostRef = database.ref().child("Events").push(this.props.eventInfo);
```



```
Events
  -LPvRuj9-i-lFmsdoFOF
    description: "Go with us, you will win!
    end: "2018-01-04'
    kind: "Tennis'
    location
      latitude: 10.83362ε
      longitude: 106.73130⁄
    start: "2018-02-01'
    status: "Rejected'
    title: "Tennis Master'
  -LPvSoiJFL_iY9uzaDrH
  -LPvSyc5hzMWMPKPMvV6
```

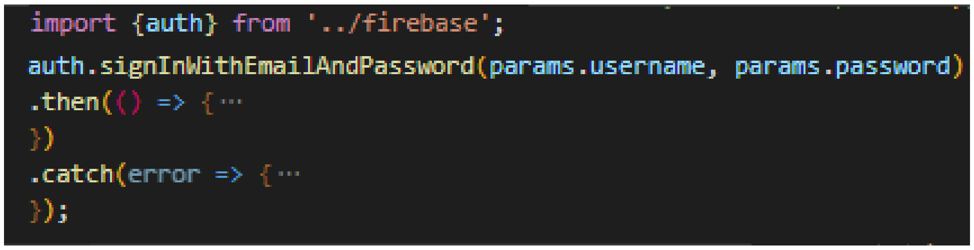
Figure - Firebase Realtime Database view



```
-KtEzDIHJJgbmz-mZMo4
-KtEzDJ93hzUjJaucNJJ
ccpr_9ssPr4:APA91bEKAXLOf7qZmhzazHdMBfX1Tlik0CNBUklVpFKZ9k0DdSrEADdogKr6ClYrHc1jhOnpzEFa1Q0eqAirpwtkkVg
dJv1hlamHsg:APA91bHZWG7V190dzUmHWSZ7hSVPkzkl8CSmM4Sym8FgIj3fUsIWOSMCocAIYxpkH7hZR_dOoFeDXgkRUav0H
e6g_DM3RXM0:APA91bHCtlptXJiD3AcrmHNsnwQFqCMQ2JVNPplr7jAQ1luTc2NB5DR0hLzuEEVYl5E3VCVzDf7bOkT8LeHw-RE
```

Figure - Synchronous database in real time

- Authentication in Firebase is used to verify that whether user has registered or not:



```
import {auth} from '../firebase';
auth.signInWithEmailAndPassword(params.username, params.password)
.then(() => {…
})
.catch(error => {…
});
```

Figure – Using authentication in application

2. Result

2.1. Mobile application

2.2. Web application

V. CONCLUSION

1. Experiences

* I have gained many things after ran this thesis project:

- Firstly, I got a knowledge about React Native, a very similar to Javascript language. It is not only easy to learn and build a project by React but also use it to compile and run an application on multi platforms like a native application.

- Secondly, through the usage of Firebase, I made the connection to server side easier. In addition, using the combinations of functions in Firebase (Cloud Function, Real time database, Authentication) help to make the application becomes more interactive and works smoothly.

- Thirdly, I used NoSQL database for managing data and then it helps me to work with Json - a very popular data syntax - more and more efficiently.

- Finally, I have learnt many new technologies and got ability to work with new frameworks/environments. Using React Native helps me have experience to build a native application on mobile based on a single language, it will help me a lot in the future if becoming a mobile developer is the way for myself.

2. Conclusion

- React Native is gradually confirmed that it is one of the best language using for developing application on mobile. It is not for a specific platform, but it can also be embedded native language and build like a native application. The libraries of React Native is developed more and more, so it is easy to find one that satisfy product requirements.

- Beside that, using Flux architecture also help to manage product more efficiently. Applying Flux makes states is more clearly, so it makes application is easier to maintain and update.

- Firebase is also a good platform for developing mobile and web application. It contains many solutions help to manage and use data, especially notifications and messages system, etc. It also provides the storage to store/retrieve data as Json object at real time, which is very convenient for online applications on mobile.

REFERENCES

[1], [2] https://docs.expo.io/versions/v31.0.0/workflow/logging

[3] https://firebase.google.com/docs/database/security

[4], [5] https://firebase.google.com/docs/database