INSTITUTE of TECHNOLOGY CARLOW
Institiúid Teicneolaíochta Cheatharlach

Software Development Final Project

Driving Companion App

Research Report

Student: Chi Ieong Ng C00223421

Supervisor: Hisain Elshaafi

Submission Date: 05/11/2021

Abstract

This Research Document is part of my final year project in ITCarlow Software Development Year 4. I decided to develop a mobile app called the “Driving companion app”. The app will score and give feedback to drivers by monitoring their driving behavior. The research document investigates various relevant technologies and issues around driving behaviors. It also includes researching the market and comparing the project to related applications. This document aims to help build knowledge on the topic and facilitate the subsequent phases of the project.

Table of Contents

1. Introduction

With economic growth, the number of motor vehicles and drivers increases, and the pressure on road traffic is also increasing. According to data from RSA (Road Safety Authority), in 2020, there were 137 fatal traffic accidents on Irish roads, resulting in 148 deaths, or 12.3 deaths per month. The driving behavior and habits of motor vehicle drivers are leading causes of traffic accidents. By analyzing motor vehicle drivers' driving behavior, we can find potential threats to urban traffic. We will be alert and correct the abnormal driving behavior of drivers in time, which can be effective in preventing and reducing the occurrence of traffic accidents.

This project aims to develop an application to monitor the user's driving-related behavior in response to the abovementioned problems. The application will give scores and feedback by analyzing the users of driving-related behaviors such as speed, acceleration, braking, road and environment, etc. The program will provide scores and feedback. This application can apply to private vehicles, vehicles, and school buses and can be used in insurance, banking, and traffic management on the market.

2. Market demand and value

This application can apply the scenarios to private vehicles, commercial vehicles and business purposes:

- Private vehicle drivers can improve their driving behaviors through driving scores and feedback, and good driving behaviors may help reduce insurance premiums.
- The commercial/employed drivers such as taxis and vehicles, through this application, evaluate their driving scores to adjust the assessment and employment of drivers for managers, timely reduce and prevent serious traffic accidents.
- The commercial market can provide information on drivers' scores for insurance, banking and other industries, evaluate the insurance premiums or mortgage services, etc., to increase profits and reduce losses.

3. Driving behaviors

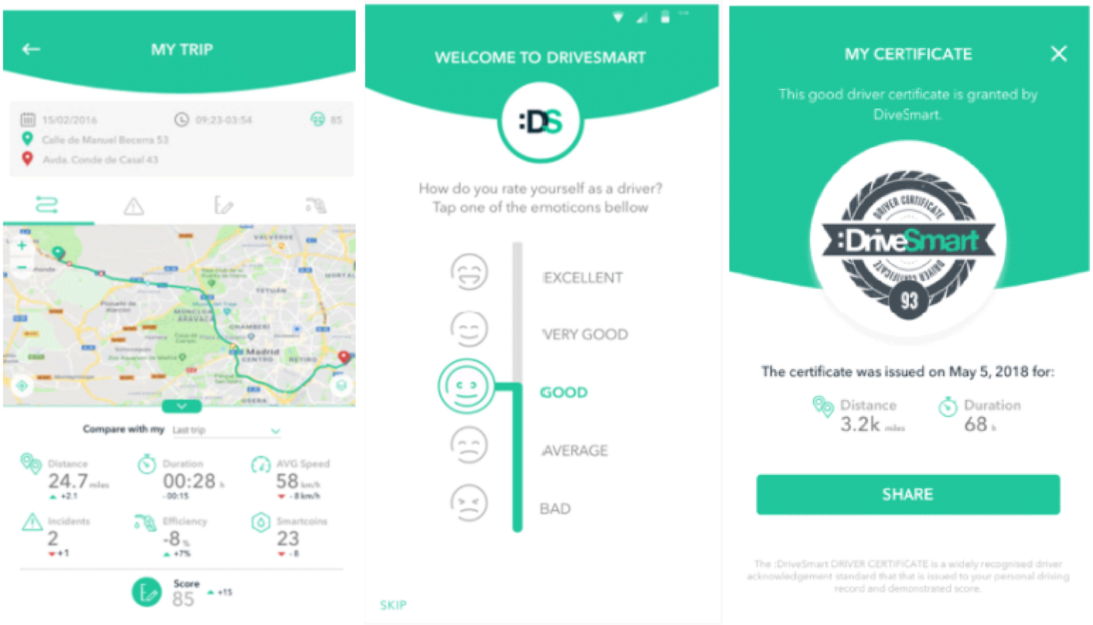
Define the driving behaviors as follows:

- Speed - the driver should not exceed the maximum speed limit at any time, and the driver should not lower the minimum speed limit on motorways/highways;
- Acceleration and braking - No unnecessary speed ups and downs, such as the start and stop at traffic light;
- Driving distance - Keep a safe braking distance from the vehicle in front. The safe space for a small car is speed divided by 2 (meters), and for a large vehicle is a rate minus 20 meters;
- Driving route - Always maintain the driving route, and don’t change lanes and overtake too much, pass on the left lane, even cross the pedestrian path;
- Attention - use hands-free mobile phones to talk while driving, avoid overtime driving.

4. Related Mobile Apps Research

4.1.DriveSmart

DriveSmart is a free mobile app that monitors users' daily driving. It will record all user trips according to user brake, accelerate, turn, react to signals, proper speed, etc. It can analyze and give feedback to improve how users can drive comfortably and safely and become good drivers. It also includes driver certification.



How do you rate yourself as a driver?
Tap one of the emoticons bellow

This good driver certificate is granted by DiveSmart.

The certificate was issued on May 5, 2018 for:

The :DriveSmart DRIVER CERTIFICATE is a widely recognised driver acknowledgement standard that that is issued to your personal driving record and demonstrated score.

Fig 1 - DriveSmart screenshot

Features include as follows:

- Can create an account by using Google or Facebook account;
- The operation is simple, press the “Start” button before starting the trip, and press the “Stop” button after arriving at the destination;
- Rating drivers are divided into five categories “Excellent”, “Very Good”, “Good”, “Average”, “Bad”;
- Through driving to get smart coins, when users collect these coins to a certain quantity, unlock achievements and upgrade the driving level to gold, silver and bronze, etc.
- It can provide a free digital driving skill certificate for good drivers.
- Users can leave comments to the development team under support center services

Compare this project and DriveSmart:

The similarities or worthy of reference:

- The operation is simple "Start" and "Stop" buttons to perform drive monitoring, and users do not need to be distracted by the app while driving;
- Based on the user's driving behavior to give points, such as speed, acceleration, braking, etc.;
- Rating drivers may be very similar.

The difference:

- No gold, silver and bronze grades;
- No driving certificate;
- No support center for human resources;
- The Project App will compare scores with other drivers.

4.2.Waze

Waze is a driving navigation program; it can plan routes and provide real-time traffic conditions, speed cameras, traffic accidents, etc. Other users can report traffic congestion to effectively plan better routes for other users.

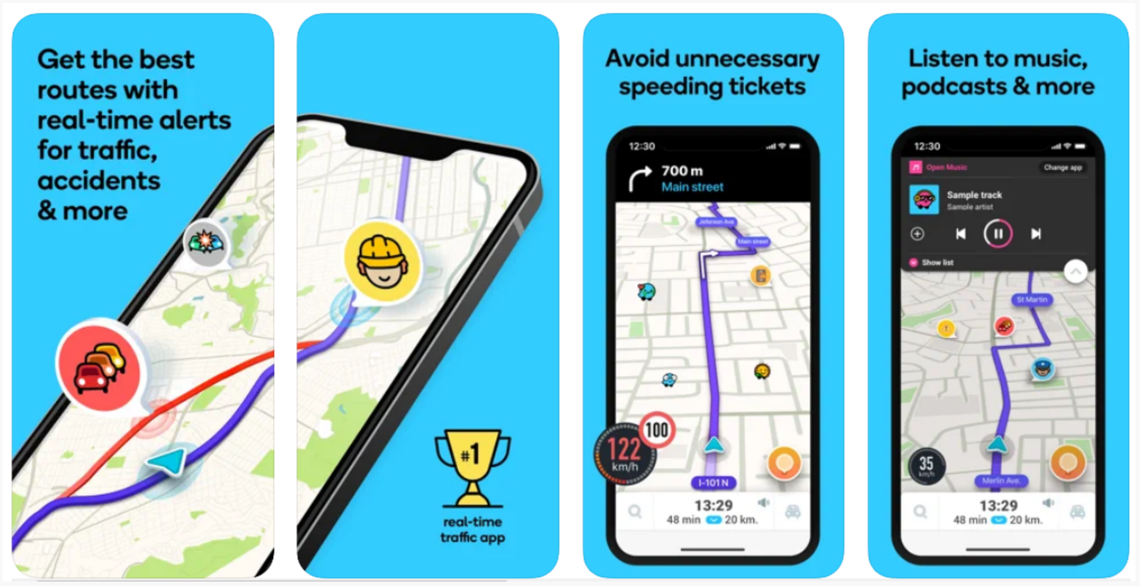

Get the best routes with real-time alerts for traffic, accidents & more
#1
real-time traffic app
Avoid unnecessary speeding tickets
700 m
Main street
122 km/h
100
13:29
48 min 20 km.
Listen to music, podcasts & more
Sample track
Sample artist
35
13:29
48 min 20 km.

Fig 2 - Waze screenshot

Features include as follows:

- The excellent navigation system will find the best route to the destination
- Report real-time traffic conditions and change routes in time
- Provide nearby gas station prices
- Help find the most suitable parking space
- Can display current car speed on the interface

The functions of Waze and this project are in different directions. Waze is mainly used for navigation and does not score and feedback for driving behavior. Still, its excellent map information and real-time traffic reporting functions are worthy of reference for some of the additional parts used in this project.

5. Hardware Research

Although this project has decided to be a smartphone application because the popularity and convenience of mobile phones are indisputable, smartphones compatible with iOS and Android occupy the most significant market. I believe everyone knows the benefits of mobile phones, so this paragraph will not use as a survey for smartphones. But there is another kind of hardware equipment that has potential capabilities, it is telematics, and made the subsequent investigations as below:

5.1.Telematics

Telematics is a built-in system used in various transportations, such as cars, trains and ships. Through wireless communication technology, satellite devices are connected to the Internet to provide drivers with different information.

Fig 3: Telematics Guide (iCompario 2021)

Its main features are as follows

- Satellite positioning
- Roadside assistance
- Car theft prevention
- The automatic collision avoidance system
- Vehicle condition control
- Personalized information reception
- Multimedia entertainment information reception
- Emergency warning system

Many automobile industries have installed telematics as standard equipment in automobiles. Because it is bound to vehicles, some insurance industries or commercial vehicles will require their applications installed in telematics.

The telematics application has potential for future development for this project, but now it is mainly aimed at smartphones as the leading development platform.

6. Technologies Research

This section is about researching standard technologies for developing smartphone applications, including frameworks, programming language, libraries and databases, etc.

6.1.Native App

Native App is a native operating system based on smartphones such as iOS and Android and uses native programming to write and run third-party applications. Generally, used programming languages are JAVA, C++, and Objective-C for development. Because it is located above the platform layer, downward access and compatibility will be better, and it can support online or offline.

6.2.Web app

Web App is an application embedded in browsers to implement Web technology functions. The front-end webpage is made using HTML / XHTML / HTML5 + CSS + Javascript, and the back-end is developed using programming languages such as PHP, ASP.NET, JSP, RoR and links to databases or other data sources. Users only need to enter the URL and execute it in the web browser, But the webapp must connect the device to the internet.

6.3.React

React is a JavaScript library for building user interfaces, and Facebook developed it. It has also been officially used to build the Web version of Facebook and Instagram services. It is “View” in MVC (Model-view-controller), so React can also use it with other Frontend MVC frameworks. The core design ideas of React can be divided into Component-Based, Declarative UI / JSX, VDOM (Virtual Document Object Model), and Diff algorithm. It is suitable for building interactive and complex user interface applications.

6.4.React Native

React Native is an open-source UI software framework developed by Facebook. The purpose is to allow developers to use JavaScript and React to develop applications on multiple platforms. Most of the applications developed by React Native are used on iOS and Android. It uses Virtual DOM and only needs to write a kind of code for cross-platform, which significantly improves development efficiency.

6.5.JSX

JSX is a syntax extension to JavaScript. It is mainly used to write the appearance of the user interface in React. It executes faster because it is optimized after being compiled into JavaScript.

6.6.Node.js

Node.js is JavaScript running on the server. It is a platform based on the Chrome JavaScript runtime, and it is an event-driven I/O server-side JavaScript environment. Based on Google's V8 engine, the V8 engine executes Javascript very fast and has outstanding performance.

6.7.Flutter

Flutter is an open-source mobile application software development kit developed by Google. Its engine is mainly written in C++ and provides low-level rendering support using Google’s Skia graphics library. Android and IOS also provide Platform-specific SDKs. It can use one programming language (Dart) to create cross-platform applications with Android and iOS and supported Web and desktop applications.

Flutter is a widget-based technology. It can apply object-oriented programming to any element and easily modify or customize widgets.

Flutter has numerous advantages over its competitors. These advantages are inherent in programming languages and development toolsets, allowing Flutter to solve problems that other languages cannot.

- One codebase for all platforms
- Widgets offer countless possibilities
- Rich libraries
- Fast testing with hot reload

Now Flutter is widely used to create apps for Alibaba, Yandex, Airbnb, Uber, eBay and other leading companies. Many excellent social media apps, service booking apps, productivity measurement apps, utility apps, product distribution apps and healthcare apps, all built with Flutter.

6.8.Dart

Dart is a programming language developed by Google. It is an Object-oriented language similar to JavaScript. It can compile to either native code or javascript, and its grammatical style is close to the C language. It is a programming language very suitable for web and mobile application development. Dart can be executed on a native virtual machine, converted Dart code to JavaScript, and then performed directly on the Javascript engine. Dart can quickly use the Library provided by Google, and users can also offer their self-written Library for other developers or other projects to use.

6.9.Google Maps API / Roads API

Google Maps API is a Maps programming API provided by Google for developers. It allows developers to embed Google Maps data into web apps by using Javascript. Mainly used to get location, navigation, and map service. Roads API is part of Google Maps API. It maps GPS coordinates to the road and determines speed limits and road segments. It is available via a simple HTTPS interface to expose Snap to roads, Nearest roads, and Speed limits services. And it is compatible with Java and Python. Its libraries make development more accessible by providing simple, native implementations of everyday tasks, such as authentication, request throttling and automatic retry. However, It is not entirely free to use. Google will charge it after the primary free usage is exceeded.

6.10.Geolocation API

Geolocation is an application based on geographic location by HTML5 embed application. It can obtain the location from network signals such as IP address, RFID, WiFi and Bluetooth MAC addresses and GSM/GSM/CDMA. Geolocation can provide location data such as latitude, longitude, altitude, speed and heading, the accuracy of the acquired location data, and the approximate time. It is compatible with Java and Python, And it is free to use.

6.11.Firebase database

Firebase is a back-end cloud platform (BaaS: Backend-as-a-Service) that provides real-time database service. It is a NoSQL cloud database and supports Android, iOS and Web apps. It can save data in JSON format and synchronize to the online client in real-time. And even if the user is offline, the data is still available.

6.12.SQLite

SQLite is an open-source, embedded relational database. A C-language library implements a small, fast, self-contained, high-reliability, full-featured database engine. It is easy to read and write Ordinary disk files and supports cross-platform database file format between 32-bit and 64-bit systems. Its benefits are easily extended. It loads only the required data and not the entire file. Installation is not needed; a configuration is not required. It is a popular choice as an Application File Format.

7. Technologies comparison

This section compares the advantages, disadvantages and differences between selected technologies, which one is more suitable for use in this project:

7.1.Native app VS Web app

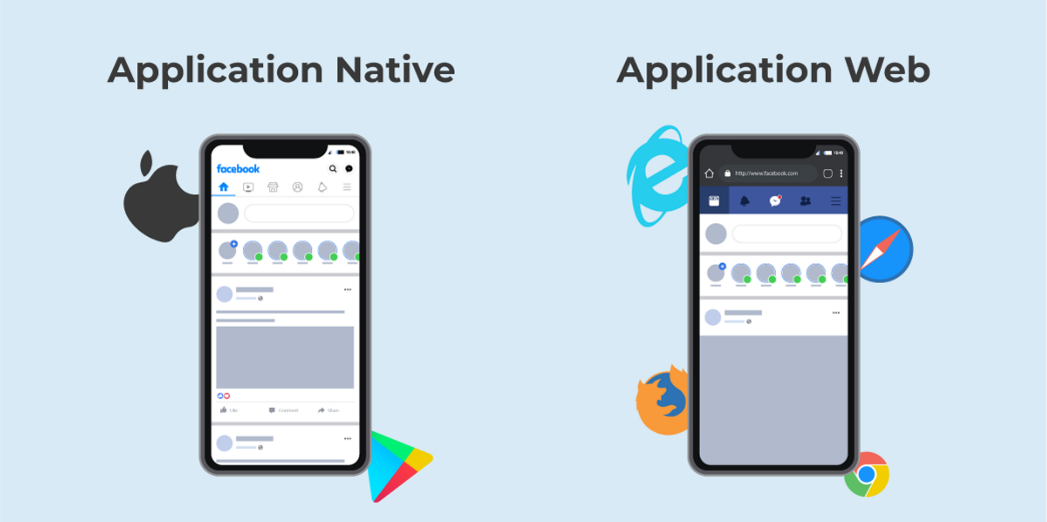


Fig 4 - Native app vs Web app (Nicolas, Pandasuite 2017)

First of all, Native apps need to be installed, and usually, it is downloaded through Google or Apple stores, And Web apps are more convenient. Users only need to enter the URL in the browser to access and use. even don't need for one-time download and installation, but the Native app executes faster than Webapp;

Native apps have access to all device-specific features, but Webapp can only use certain device features;

A native app can work without an internet connection, but Webapp relies on the Internet;

Each update of the Native app needs to pass the Google or Apple store review, but the Web app can update immediately, and all users are updated uniformly.

However, In this project, target users use this application while driving on the road. So considering some road sections with unstable networks, a Native App that does not need to rely on the Internet should be more appropriate. And Native apps are easier to access device features, and the data can be stored offline until the device is online and uploaded to the cloud server.

7.2.React Native VS Flutter

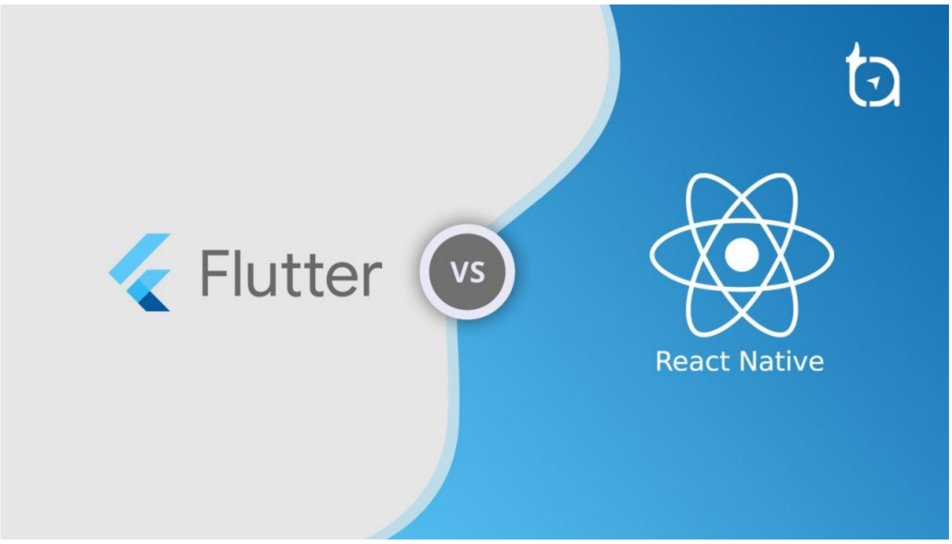


Fig 5 - Flutter Vs React Native (Abishek Surya RS techaffinity 2019)

First of all, from the chart below, we can know that React Native and Flutter are both mainstream for smartphone app development, and according to the data in 2020, the users of both are very close. These frameworks are manufactured and supported by the industry's most prominent technology giants, Google and Facebook, so both will become the future.

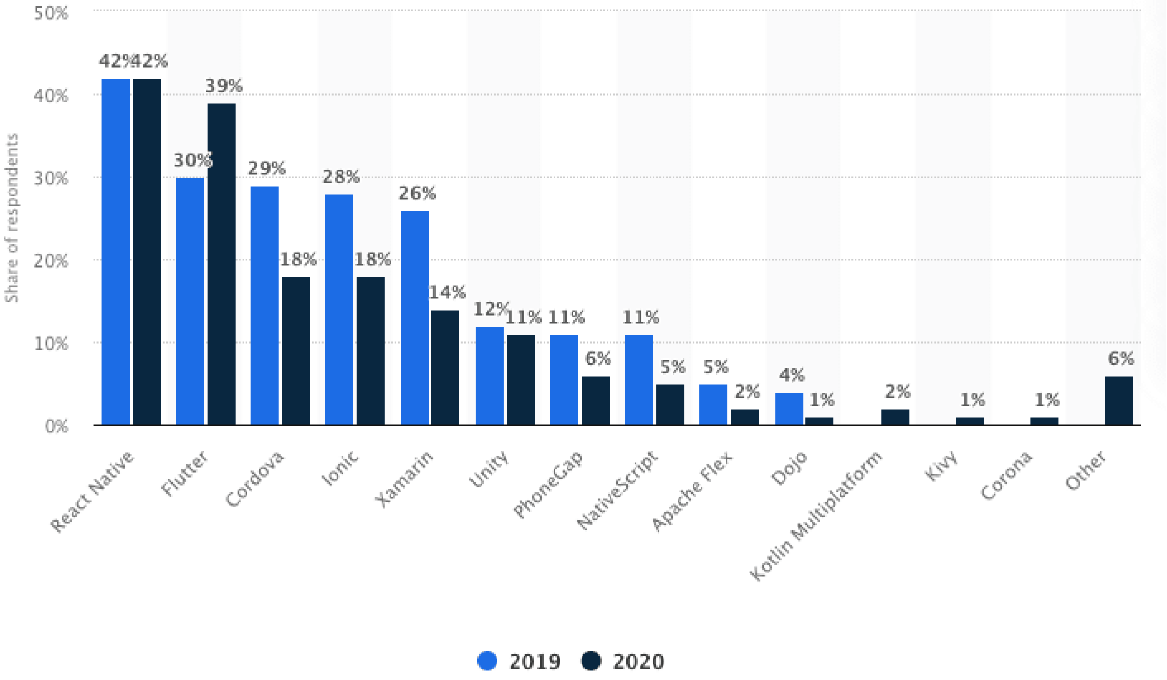


Fig 6 - Flutter Vs React Native Market Share (AgileTech 2021)

Flutter is faster than React Native in coding in framework performance, but React Native has been successfully applied to small to large projects, such as Facebook, Instagram, etc. It has more mature development technology.

Flutter can be applied more smoothly and faster than React Native through the Skia graphics library in the FPS animation standard.

Flutter has its UI components and widgets, but React Native only provides a basic widget. Therefore, Flutter provides better UI customisation and makes it consistent across platforms.

React Native mainly uses JavaScript and Flutter uses Dart. Javascript is considered the default language of almost all browsers and is easy to adopt. Still, Dart is an object-oriented programming language and is not known widely in the development community.

As a result, No matter which one is in use, both are also good choices. However, Flutter is a newer framework. It owns a lot of UI components and widgets, and it should have more significant potential. With zero experience in smartphone application development, it is good to learn new things during the college project.

8. Conclusion

After a series of research, including market, driving behaviors, related applications, technologies, and comparison, the development has a primary direction.

This project aims to make a smartphone app compatible with Android platform. The user operation should be as simple as DriveSmart. Press the "Start" button before driving and press the "Stop" button after driving. Do not disturb driving, and scoring is performed in the background. Eventually, users can browse the latest and past driving records and view the score with feedback.

All mentioned technologies in this Document are the effectiveness and quality to be used in this project. Compared to Webapp, the Native app is more suitable as it is easier to access smartphone device features. Flutter is a good choice for development, and it suits the requirements of this application. Flutter mainly uses Dart, so the programming language for this project will be coding in Dart. It is a new simple programming language suitable for beginners, and it will be familiar and easy to use for developers who have learnt Java, C++, etc.

The following project process, the Functional Specification and Design Document, will shape this project more clearly and fill in some of the still unclear aspects of this research document.

9. Bibliography

RSA 2021, Deaths on Irish roads 2020, available on
https://rsa.ie/en/RSA/Road-Safety/RSA-Statistics/Deaths-injuries-on-Irish-roads/

RSA 2021, Rules of the Road, available on
https://www.rsa.ie/Documents/RotR%20BOOK%20for%20web%202019.pdf

Nauto 2021, What is Driver Behavior, available on
https://www.nauto.com/glossary/what-is-driver-behavior

DriveSmart 2021, official website, available on
https://drive-smart.com/

Binarapps 2021, What is a Native Mobile App, available on
https://binarapps.com/what-is-a-native-mobile-app-whats-worth-knowing/?gclid=CjwKCAjw2vOLBhBPEiwAjEeK9t-RyyQX5Co8fqvqEBd4ngd4048hgci03ZBCKa0OIwRfRGbamoar-xoCQrMQAvD_BwE

Geeks 2021, The benefits of using web-based applications, available on
https://www.geeks.ltd.uk/insights/the-benefits-of-using-web-based-applications

React 2021, Introducing JSX, available on
https://reactjs.org/docs/introducing-jsx.html

W3school 2021, Node.js Introduction, available on
https://www.w3schools.com/nodejs/nodejs_intro.asp

Elitech 2021, Flutter App advantages and disadvantages, available on
https://www.elitechsystems.com/start-with-flutter-basics-the-good-and-the-bad/

Abishek Surya RS. techaffinity 2019, Flutter vs React Native, available on
https://techaffinity.com/blog/flutter-vs-react-native/

Dart 2021, Dart overview, available on
https://dart.dev/tutorials

AgileTech 2021, Flutter vs React Native, available on https://agiletech.medium.com/fluflutter-vs-react-native-which-is-the-best-development-trend-in-2020-8fee7c059fd6

Nicolas, pandasuite blog 2017, Native app vs web app, available on https://blog.pandasuite.com/native-app-vs-web-app/

Back4App 2021, Top10 Advantages of Firebase, available on https://blog.back4app.com/advantages-of-firebase/

SQLite Tutorial 2021, SQLite Tutorial, available on https://www.sqlitetutorial.net/

Google 2021, Google Maps Api overview, available on https://developers.google.com/maps/documentation/javascript/overview

MDN Web Docs 2021, Geolocation API, available on https://developer.mozilla.org/en-US/docs/Web/API/Geolocation_API

iCompario 2021, 5 Minute Fleet Telematics Guide, available on https://www.icompario.com/en-ie/telematics/5-minute-guide/