

# A Comprehensive Comparison of Hybrid Mobile Application Development Frameworks

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## ABSTRACT

The number of users of smart mobile devices is growing every day. Because of the popularity of using mobile devices, it is important for business stakeholders to develop mobile applications targeting all mobile platforms in order to ensure that the number of users is as large as possible. One possible solution is the creation of hybrid mobile applications. These are applications that combine the properties of web and native mobile applications, and their main advantage is compatibility with multiple mobile operating systems. This paper presents the results of very comprehensive experiments that involved the use of various hybrid mobile development frameworks that were tested under different scenarios. Experiments revealed that the performance of hybrid applications in different scenarios varies considerably, although the results of these applications were comparable to those that were achieved in the experiment with the native application.

## KEYWORDS

Android, Flutter, Framework, Hybrid Mobile App, Ionic, NativeScript, React Native

## INTRODUCTION

Nowadays, the number of users of smart mobile devices worldwide exceeds 3 billion, and the growth trend of their use will continue in the coming years. This indicates the number of new mobile phone users, which increased from 2018 to 2019 by 300 million. Mobile devices still have great market potential in the markets of the most populated countries, such as China and India (Statista, 2019a). In India, the share of smart mobile device use in 2018 was only 24% (Statista, 2019b). Mobile operating systems are adapted to the capabilities of the devices, so companies and developers need to choose the right approach for building applications to ensure as many potential users as possible (Fister Jr. et al., 2018; Martinez & Lecomte, 2017). The market is currently dominated by mobile devices with two operating systems - Android and iOS, which, together, cover more than 98% of market share (StatCounter, 2020). The program codes of native mobile applications running on the Android and iOS platforms are incompatible with each other, due to the use of different tools and programming languages when creating an application (Majchrzak et al., 2017). The consequences of this are separate

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projects and different development environments for developers who create the same applications for both operating systems (Biørn-Hansen et al., 2017). One possible solution is to create hybrid mobile applications. These are applications that combine the features of web and native mobile applications, and their main advantage is compatibility with multiple mobile operating systems. These applications use dedicated frameworks and interfaces that allow the use of native functionalities of mobile devices while simplifying the development of applications using modern web technologies (Vilcek & Jakopec, 2017). Their main drawbacks are lower responsiveness and possible poorer user experience, due to the non-use of native components (Delia et al., 2017). Therefore, it is important for companies and developers to choose the appropriate technology or framework with the least number of shortcomings when developing hybrid mobile applications.

The contribution of this paper is twofold. Firstly, our mission is to present the comparison of the development of hybrid mobile applications, as well as the theoretical foundations of the selected hybrid frameworks for their development. Secondly, the selected hybrid frameworks are used for the development of simple mobile applications and their evaluation under different scenarios.

The structure of this paper is as follows: Section 2 presents a theoretical insight into hybrid mobile applications. This Section is followed by a presentation of selected frameworks for the development of hybrid mobile applications (Sec. 3). In Section 4, we present the selected criteria for performing the experiment, the application development plan, and describe the development of an individual application. In Section 5, we present the results obtained during the experiment, and in the final Section 6, we summarize briefly our findings in the development of applications and the implementation of the experiment, with which we compared their performance.

## HYBRID MOBILE APPLICATIONS

Hybrid applications combine the features of native and web technologies, and enable compatibility with multiple mobile operating systems (Vilcek & Jakopec, 2017). The most important features of hybrid applications are the common program code and the development environment, which differ in the case of the development of native applications (Delia et al., 2017). Such an application development concept is called “write once run anywhere”, and refers to the ability of an application to run on different operating systems (Huynh et al., 2017). The development of hybrid mobile applications is carried out using modern technologies that differ depending on the selected framework in which we create the application (Ma et al., 2018). For example, those built in the Ionic framework use the Apache Cordova interface and run within the web view, while applications built in the React Native framework use an interface that allows the application code to be mapped to native application components (Griffith, 2017; Eisenman, 2017).

Most frameworks for developing hybrid mobile applications are based on web technologies such as HTML5, CSS, JavaScript, and web frameworks. Despite the use of web technologies, these applications can also work offline and store data in local databases such as SQLite and Realm, which are installed on mobile devices as part of the application (Huynh et al., 2017; Parihar, 2020). Like native applications, hybrid applications can also access many functionalities (data storage, notifications, contacts, gallery, etc.) and hardware (motion and vibration sensor, camera, navigation, gyroscope, etc.) built into modern mobile devices. Hybrid mobile applications can also be published in the online stores of individual mobile operating systems, from which users install them on their mobile devices (Griffith, 2017).

## FRAMEWORKS FOR MOBILE APPLICATION DEVELOPMENT

In the following subsections, we present the four selected frameworks for mobile application development.

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