Evaluation Form – Technical Background Review

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Technical Content
- Current state-of-the-art and commercial products
- Underlying technology
- Implementation of the technology
- Overall quality of the technical summary

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Use of Technical Reference Sources
- Appropriate number of sources (at least six)
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- Quality of the sources
- Appropriate citations in body of text
- Reference list in proper format

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Parking Lot Mapping Drone (aiValet)

Mobile App Development Technical Review

Modern Mobile App Development Frameworks

Introduction

With the advent of smartphones, mobile applications have become a staple in everyday life. Almost any website or mobile service is replicated as a mobile app to increase a product or service's accessibility [1]. A variety of frameworks have been developed within the recent decade to match pace with the production of new smart-devices developed, the variety of functionality for different applications, and the constant updates of different operating systems.

Commercial Applications of App Development Tools

The most relevant mobile frameworks, like React Native, Flutter, Cocoa Touch, and Kotlin, are all free resources, as is the case for many software frameworks. Despite this, costs of applications with millions of users can be upwards of one billion dollars. For example, Uber was originally started with about $200 million in seed funding (a relatively small, upfront, investment used to develop a product, start a business, fund research, etc.), and the total funding of SnapChat was over $3 billion [2]. The cost of a mobile app typically compromises of two aspects.

First, are any features and functionalities specific to the app. Features could include "platforms you want to build for, customization of visual design, the complexity of backend infrastructure and administration, and maintenance costs" in addition to the app's direct use-case [2]. The two most relevant platforms are the iOS and Android operating systems. Visual design elements are created through a variety of tools, such as: Adobe Photoshop ($20.99/month for individuals), Sketch ($99/year per editor), InVision ($99/year), Adobe Illustrator ($20.99/month for individuals), Figma (free to $45/month), Adobe After Effects ($20.99/month for individuals), and more. The cost of backend infrastructure can fall within a wide range depending on hardware paired with the application. For example, Google Maps is frequently updated by both aerial and street level images to track the development or changes among different routes and locations [3]. Regardless of hardware, however, many mobile apps use the following "Mobile Backend as a Service" (MBaaS) platforms: Amazon Web Services (AWS), FireBase, Rest API, and GraphQL [4].

Second, is the cost of the development team, which at least consists of a Product Manager, a Scrum Master (or even a Scrum Team), Product Owner, UX/UI Designers, Developers, Business Analysts, and Quality Assurance Engineers [5]. The specific costs of the team are subject to variability according to each member's salary and the hours they have contributed to the project.

Building Blocks for App Development Frameworks and How they Work

The word "framework" can seem vague, but a software framework is simply a platform or combination of developer tools used for creating software applications [6]. Depending on each framework's purpose or specialty, it will be compromised of a different set of tools (programming language, graphics engine, UI components, testing environments, etc.). Among mobile app development, there are three types of frameworks: cross-platform, web development, and native mobile [7]. Cross-platform frameworks (such as Ionic, React Native, Flutter etc.) are capable of running across a multitude of platforms (Android, iOS, Windows, etc.) without the need to change languages, and should require minimal debugging to interface with different operating systems [8]. Web development frameworks (like ReactJS, Ruby, Django, etc.) aren't specific to mobile apps, but are used for a variety of webservices [topflight]. Finally, native mobile frameworks (like SwiftUI, Realm, JetPack, etc.) often have ready-made libraries and APIs for specific platforms [7]. For instance, frameworks like Cocoa Touch and SwiftUI are used for iOS development only [7].

Because reaching a wide range of users is critical to an application's success, many developers prioritize the use of cross-platform frameworks to keep development time short and save the cost of having multiple developer work on different native mobile frameworks in parallel [9]. The two most used cross-platform frameworks currently are Flutter and React Native.

Flutter

Flutter is a framework created by Google in 2017 and has been used in several recognizable apps, like BMW, Google Ads, Ebay, Stadia, GroupOn, and the New York Times [10]. It uses an object-oriented language with syntax similar to Java and JavaScript, Dart (also developed by Google). It also uses Skia as the foundation of its application architecture [13]. Application architecture defines patterns, techniques, and design choices for the framework to use as a guide for a finished application [11]. For its UI components, Flutter rarely needs third-party libraries as the framework has a variety of bundled UI components, device API access (used to connect devices to web-based clients), and its own included libraries [13, 14, 15]. Flutter also has a variety of testing features denoted as unit, widget, and integration testing. Unit testing allows for testing on a single portion of code (like a single function or class). Widget tests can isolate portions of the UI for targeted testing. Finally, integration testing runs a complete test of the entire app [12].

React Native

React Native is a framework developed by Facebook in 2015 and is the most widely used framework among mobile applications. Apps in React Native are programmed in JavaScript (due to the language's prevalence in web development). The Flux API serves as its application architecture. Unlike Flutter (aside from a small library of basic components), many native UI components are from separate,

third-party libraries. Many of the framework's most popular testing tools (like Appium and Detox) are also third-party libraries [13, 14, 15].

Implementation with Project

Large parking lots are often difficult to navigate, in terms of finding a parking space and remembering where a vehicle was parked. The goal of the project is to design a mobile app which allows users to find available parking spaces as they enter the lot, and easily find their car as they leave. Data on the status of parking spaces will be determined by fixed cameras surveying the lot. With this information, the team must decide which cross-platform framework (to run on both iOS and Android) will be able to smoothly integrate with the image processing data collected in the backend.

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