



The Design and Implementation of a Libyan Salary Mobile Application using Flutter

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Abstract: Mobile applications have become widespread in many aspects of our daily lives. Many people do most of their work via their phones, such as online banking, shopping, etc. Due to many individuals being unaware of their salary details, this paper presents a design and implementation of a Libyan salary application” الراتب” using Flutter (cross-platform). The application allows users to know details of their salaries, including bonuses and deductions according to the salary schedule of each ministry or sector. The application currently contains salary schedules for ten ministries. The implementation consists of the following four steps: data collection of laws and payroll tables for each ministry to use as a local database for the salary application, design of friendly-use application screens using Flutter, integration of the mobile application with Firebase (backend platform by Google), and finally, preparing and deploying an Android and web version of the salary application. The results that were obtained from reviewers in the Google Play Store were satisfactory. There is an increasing local demand to add other ministries to the application. The citizens of the local community encourage providing such a service, which is considered the first of its kind. The application reached more than 100k downloads in less than a year, and the average rating is 4.5 out of 5 in the Google Play Store at the time of writing this paper.

Keywords: Mobile Application; Flutter; Cross-platform; Salary Application.

INTRODUCTION

Nowadays, smartphones are the most used device in the world. Therefore, almost each company needs to build a mobile application for its business to reach as many audiences as possible. Developers tend to target mobile operating systems that are widely used, which are Android and iOS. These mobile operating systems are used in total by more than a billion mobiles. Android is an open-source system acquired by Google in 2005, while iOS is a mobile operating system created and developed by Apple Inc for iPhone and iPod Touch. There are a significant number of mobile apps published in the Google

Play Store for Android mobiles and the App Store for iOS mobiles. The Android apps are written in Java and Kotlin, while iOS apps are written in Swift and Objective-C. Many companies currently work in mobile application programming. They usually have two teams or even more. One team focuses on building Android applications, and another team works on iOS applications. In addition, they might have some developers who work on web applications. It might be a better solution to have several teams designing and building apps for different platforms. However, small companies cannot afford to pay many employees.

With the existence of software development kits (SDKs) that have a cross-platform feature, this platform is based on the concept of building once and running everywhere. One of those SDKs used in this work is called Flutter. It is an open-source SDK released by Google in 2016. Flutter is based on Dart programming language, which is an Object-Oriented Programming (OOP) language. In Flutter, each component that appears on mobile phone screens is called a widget. Therefore, it's considered the principal item in this SDK. Flutter also has a hot-reload feature, which boosts the coding time because any change during writing code will be updated directly in the dart virtual machine. Consequently, we can notice these changes on a real device or an emulator once we run the code. Furthermore, the code written in Flutter can deploy to multiple platforms such as Android, iOS, desktop, web, etc.

Flutter has been used to build various apps. The Billing and Reward App was built using Flutter. Users gain points for shopping, and those awarded points can be used for purchases after reaching a specific amount. The app consists of a client-side which is running on Android or iOS-based smartphones. They also built a server part on a Windows OS for system management (Tashildar et al., 2020). Ghusoon Arb and Kadhum Al-Majdi designed a freight app based on Dart and Flutter. They published their app on Android and iOS devices. On the client side, customers who use the app were able to track the details of their packages, including the cost and location. On the server side, charging staff uses a framework to modify dispatch states (Arb & Al-Majdi, 2020). The Evecurate app also uses the QR for event management at universities. Event details such as the date and time can be announced via the app (Juliana et al., 2021). Due to the COVID-19 pandemic, much research has been carried out to help people in different life aspects. One of those useful works was developing a healthcare app that provides many services. Many patients can be diagnosed via this app. In addition,

you can easily ask for an ambulance vehicle. The app also enables patients to order their medicines online (Mamoun et al., 2021). Praveen et al. used Flutter to build a conference room booking app. People can use this app to book conference rooms based on availability (Praveen et al., 2020). A food services app was also developed using Flutter and MySQL (Structured Query Language) to provide food to clients who order by the app (Riyadi & Cahyono, 2021). A student attendance app was built using Flutter for Android mobiles. The app uses a Quick Response code (QR) to register students during the class. Opening and closing sessions are managed by lecturers, and students and lecturers use the app as clients. Users get all necessary data from a web service by a HTTPS (Hypertext Transfer Protocol Secure) request (Wiriasto et al., 2020). A salary management system was built for a factory, using a biometric scanner to collect the attendance of employees, which is uploaded to a cloud database. The employees use a mobile app to see their salary details (Patra et al., 2021). An employee salary report application was developed for Android devices. The app uses Firebase to send employee salary reports (Dinata & Risawandi, 2021). Firebase is also used in the Libyan salary app to send notifications to users. Although, the last two research have similar applications to the Libyan salary app, the app in this paper is entirely different because it does not rely on any attendance system. In addition, it displays salaries in a general way according to salary tables for each ministry, not for a specific employee. Although Flutter has been used to solve many problems in different countries, each country has issues related to its government and individuals. The local community in Libya might need a specific mobile app that helps people in their daily life. There are many salary schedules for Libyan employees. The ministry of finance of Libya does not provide a public database for payroll tables and laws, where individuals can access this information smoothly and easily. In the current situation, for instance, someone who

works at a university knows that his salary belongs to the ministry of higher education. He might spend a couple of hours browsing on the internet until he finds what the name of the statute and payroll table for universities as a Word document or Portable Document Format file (PDF). This inconvenience also applies to other ministries and sectors as well. It is exhausting work finding this information. Therefore, all these scattered salary schedules on the internet need to be organised and displayed in a suitable manner. This was the motivation for building the Libyan salary app. The app aims to help local citizens to know all exact details about their salary in a few seconds.

MATERIALS AND METHODS

The process of building the Libyan salary app contains four main stages. The first stage involves collecting the payroll schedule of each ministry which will be stored in a local database. The second stage was to build the graphical user interface for the application screens, which were implemented using Flutter and Dart programming language. In the third stage, the app was integrated with Firebase to use for notifications. The last stage is releasing the salary app on Android and the web. Figure 1 shows the block diagram for the building process of the salary application.

Data Collection: The app currently consists of ten ministries. For each ministry, a payroll table was obtained by searching the internet for the existing employment laws of that ministry. The payroll tables were formatted to Comma-Separated Values (CSV) files in order to use in the next stage. This procedure was repeated for all other ministries. Even though this kind of work takes a long time, it is performed only once. Table 1 shows an example of the salary table of the Libyan ministry of interior. At this point, the app database had been created successfully, and the app will be able to load any of those salary tables smoothly. The first column in Table 1 demonstrates the occupation grade, which

starts from 450 Libyan Dinner (LD) for level one until 1276 LD for level sixteen. The second column shows the annual increment that corresponds to each row in Table 1. The value of the annual increment starts from 3 LD until 15 LD. As previously mentioned, this is only one instance, and these steps were applied to all ten ministries in the Libyan salary app.

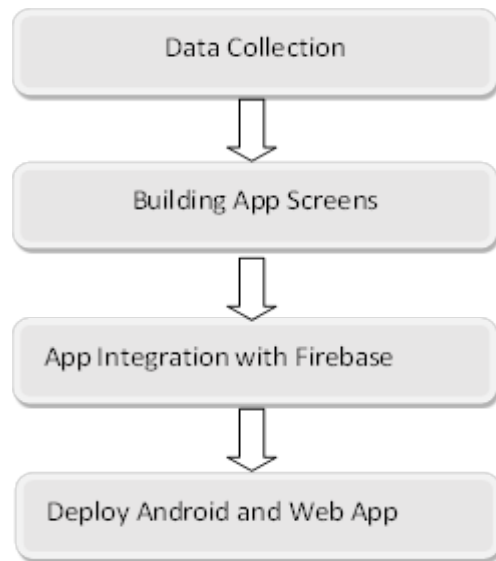


Figure: (1). The building process of the App

Table (1). The Libyan Ministry of Interior

Job Ranking	Annual Bonuses
450	3
475	3
500	6
532	6
550	8
582	9
615	9
662	9
745	12
820	12

The app uses the local database created in the first stage. As a result, getting information from any salary schedule and demonstrating it in the mobile app is performed quickly.

Graphical User Interface (GUI): The Libyan salary app might be used by many users from different backgrounds. In addition, they have different education levels. Therefore,

the app was designed to be a user-friendly mobile app. In general, a user only needs to select his occupation grade and annual increment from a dropdown button. Furthermore, there are more options for some sectors like the General Electricity Company of Libya. Its employees have overtime hours and night shifts on many days each month. Visual Studio Code was chosen as an integrated development environment (IDE) for programming the mobile app. Contrary to Android Studio, this IDE can work even with limited hardware. Visual Studio Code has an option called extensions to enable the addition of many programming languages. Flutter and Dart have been added for building this app. Figure 2 illustrates the working app architecture. As you can notice, the Android and web versions of the salary app acquire data from the local database, which contains payroll tables for all ministries. Firebase sends a notification message which contains either an update or news about salaries.

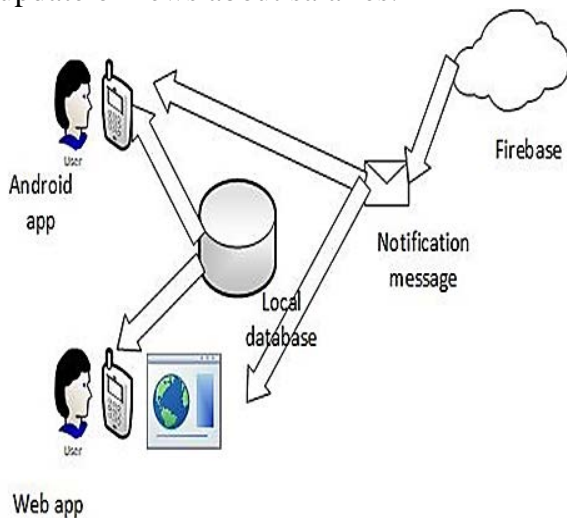


Figure: (2). Working App architecture

For the design of the GUI, as almost every app contains a login screen, it was the first screen programmed in the salary app. However, for now, to make the app as simple as possible, users will not be asked for any information. Therefore, they do not create a user profile to enter the app. App users must have an internet connection to use the app. The login screen for this app is shown in Fig-

ure 3. When the user clicks the button “دخول”, the code will run a code routine to check if there is an internet connection. If so, it will then take you to the Homepage screen as shown in Figure 4. For instance, if a user works at a university, he will click the fourth option on the Homepage screen, which is the ministry of higher education and scientific research, as shown in Figure 5. Presuming the user works as a lecturer, he will click on the first choice in the Staff screen. Consequently, the salary screen will be shown as in Figure 6. The user chooses his scientific grade and annual increment from two dropdown buttons at the top of the current screen. There is also a checkbox for teaching hours. After that, he can click the button “أحسب” to display all salary details.

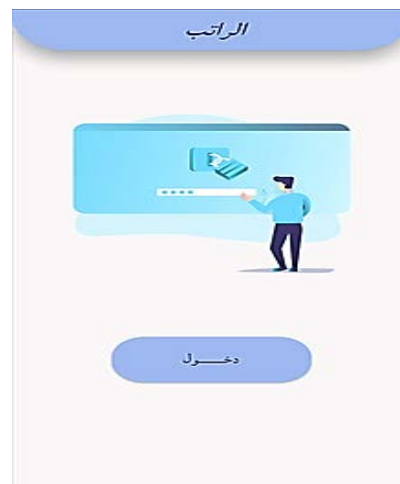


Figure: (3). Login Screen



Figure: (4). Homepage screen



Figure: (5). Staff Screen



Figure: (6). Salary Screen

App integration with Firebase: Firebase was acquired by Google in 2014. Many developers used Firebase as backend development programming language to build high-performance apps. Firebase is not limited to hosting websites as it provides many services. You can use it to store databases, which can be used later by mobile apps or websites. Nevertheless, this service is not used by the Libyan salary app because of the small size of its database. Firebase presents another backend service which is called authentication. The benefit of the service is to identify the user and allow him to use the app. It is also not used in this work because there is no registration procedure for the Lib-

yan salary application (Khawas & Shah, 2018).

Application Deployment: The salary app is released to work for Android mobiles. There are two formats for releasing apps. Either an App bundle (preferred by the Google play store) or APK (Android Package Kit). The following Flutter command is for the first option. After that, the app bundle will be ready to publish to the google play store.

VS Code Terminal

flutter build appbundle

The salary app was also deployed as a web app, which is achieved by the first command using Flutter on the Terminal window of Visual Studio Code (VS Code), as follows:

VS Code Terminal

flutter build web

flutter run -d chrome

The second command is to test the web app using the Google Chrome browser. Flutter supports Progressive WebApp (PWA). Therefore, the web app can be installed similarly to other web-based apps. Even though the salary web app was released successfully, upto this step, it only works locally. In order to make this web app available to all users, a hosting service should be used. A Firebase platform was used to host the web app version. All users can access the web salary app through the following web link:

<https://salary-webapp.web.app>

By providing a web app for this work, users will not be limited to any operating system. They can open the app from Android and iOS mobiles. The web app also can be used by a personal computer (PC) because all we need is a web browser to open the previous web app link. Firebase has a powerful feature called Firebase Cloud Messaging (FCM). It enables sharing information and sending notification messages to a specific user or group of users who use the same app, which might be an Android, iOS, or web app. FCM was

used in (Heryandi, 2018). They used FCM at university to keep parents engaged by sending them performance progress reports as a notification message. Parents can receive those messages quickly via an app installed on their smartphones without any cost. In this paper, FCM was used to send notifications to all users, as shown in Figure 7. It consists of a few steps. Firstly, choose a notification title. Secondly, write a notification text. Finally, you choose the scheduling by which you want to send the notification and click the Publish button. In the Libyan salary app, there are two kinds of notifications that have been sent. The first kind is to inform app users about any new updates.

The second kind of notification is news. Especially the news that is related to salaries, as shown in Figure 8. It displays a notification message about the central bank of Libya regarding the salary for January. Firebase also enables you to know the number of active users in the last thirty minutes via the Firebase Console. In addition, you can use Google Analytics to obtain valuable information about the application's performance. Google Admob" advertising on mobile" was used in the app for mobile advertising, where a small banner at the bottom of the app was specified for advertisements after blocking or filtering unwanted advertisement categories.

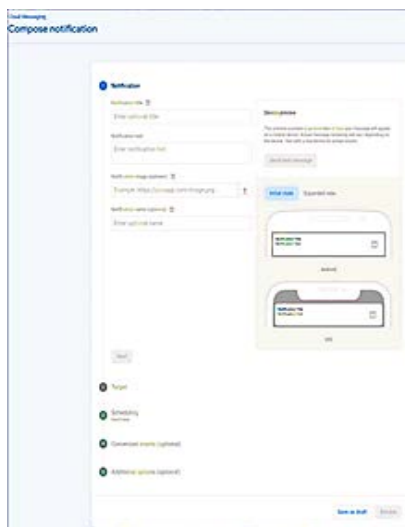


Figure: (7). Salary Screen



Figure: (8). App Notification

RESULTS AND DISCUSSION

The app has gained interest from many individuals. It has more than 50k downloads. The app has also many positive reviews. The average rating of the Libyan salary app currently is 4.5, as shown in Figure 9. This rating is a result of 403 reviewers who contributed by rating the app. The rating value might increase or decrease with time depending on new reviews. The database that was collected in the first stage was stored locally. The size of the database is 1.74 KB, which is considered a small size. Therefore, at this time, it is not necessary to store the database using a cloud-storage service. The existence of the database locally contributes to the reliability and speed of the app. Another concept that plays a role in the app performance is what is called asynchronous programming (async) in Dart programming language. A Future is a foundational class in async programming. Therefore, if you call a function that might take a long time until it returns a value, you can make that function return a future value, and the program will not remain waiting but returns to the main routine without any delay. Once the future value is ready, you can use it (Windmill, 2020).

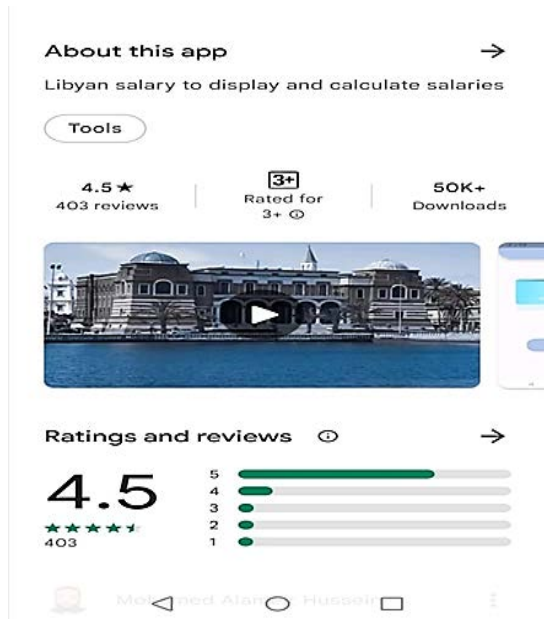


Figure: (9). App Rating

This method was used in the salary app in many cases. For instance, when the app checks the internet connection when launching or navigates between screens. Another example is bringing the correct salary table from the database. Therefore, the user will find the app working smoothly without any problems because all the previous procedures, which take a long time, are working in the background in a synchronized way. The app has been installed by users from different countries, as demonstrated in Google Analytics. However, you can notice in Figure 10 that Libya comes in the top list for user distribution per country over the last six months. It has 10k new Libyan users. Due to different users' behaviour, they might spend different times using the Libyan salary app. The average engagement time of app users was 3m 57s, as shown in Figure 11, also obtained from Google Analytics. Although, The Libyan salary app is the first to contain employee salaries from different ministries, which was released on 14 May 2021. However, there is a government app that works on Android published by the social security fund, which is called "الضمان موبايل".

The app is specified for retired people and

was released on 16 December 2020. It displays details of their pensions. However, this app differs from the Libyan salary app because it has access to the government database for the retired. Table 2 illustrates a comparison between the two apps. The first column is about the app's download size. This feature affects the required time for the app to be installed. The Libyan salary app has also a bigger size. The same applies to the second column (App size). The app size is the amount of space required by the app to be installed on your device. Cross-platform apps have a bigger size than native apps. However, there some optimizing work should be done to reduce the app size. The minimum requirement for the salary app is Android 4.4. The app in this paper has many positive reviews. It also overcomes the first app in Table 2 in the average rating with a 4.5 rating, despite it being available for less than one year in the Google Play Store.

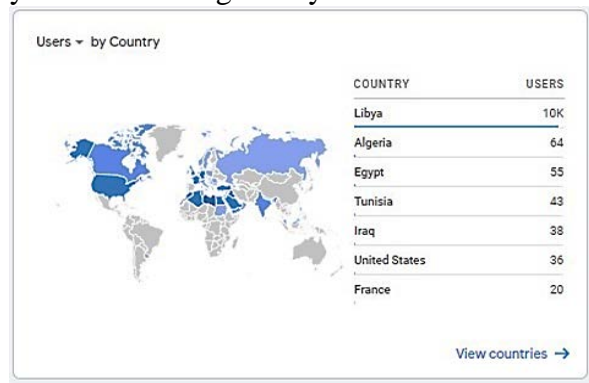


Figure: (10). Users by Country



Figure: (11). Users Engagement

Table: (2). Apps Comparison

App Name	App Download Size	App Size	Rviews	Rating
"الضمان موبايل"	6 MB	14.9MB	840	4
"الراتب"	8.3 MB	48 MB	403	4.5

CONCLUSION

The paper introduced a solution for many people who want to know all details about their salary, which includes promotions and deductions. By using Cross-Platform Development (Flutter), The Libyan Salary app was programmed to work for Android mobiles. It also works as a web application. The user needs to choose his field of work. The app will then show a screen where you can choose your occupation grade and salary increment, and with one button click, all salary details will appear. A notification service is available in the app to show news related to salaries, and notify app users about any new updates. The app has a reasonable size and great performance. Although the app has many positive comments from its users, there is a significant demand to add more ministries and sectors in the future. Other future work is to add a registration procedure, where each user can have a unique profile. As a result, he might only receive notifications related to his occupation. In addition, users' information will be protected using Firebase security rules.

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تطبيق الراتب الليبي باستخدام برنامج فلاتر

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المستخلص : انتشرت تطبيقات الهاتف المحمول في كثير من جوانب حياتنا اليومية. يقوم العديد من الأشخاص بمعظم أعمالهم عبر هواتفهم مثل الخدمات المصرفية عبر الإنترنت والتسوق وما إلى ذلك. ونظراً لأن العديد من الأفراد لا يعلمون تفاصيل رواتبهم، تقدم هذه الورقة تصميماً وتنفيذاً لتطبيق الراتب الليبي باستخدام برنامج فلاتر. يتيح التطبيق للمستخدمين معرفة تفاصيل رواتبهم بما في ذلك من علاوات وخصومات حسب جدول الرواتب لكل وزارة أو قطاع. يحتوي التطبيق حالياً على جداول رواتب عشرة وزارات. تتألف عملية بناء التطبيق من الخطوات الأربع التالية: جمع القوانين وجدول المرتبات لكل الوزارات لاستخدامها كقاعدة بيانات لتطبيق الراتب، تصميم شاشات التطبيق بحيث تكون سهلة الاستخدام، ربط التطبيق الخاص بنا مع منصة Firebase، وأخيراً إعداد نسخة أندرويد وويب لتطبيق الراتب، ونشرها. ومن الجدير بالذكر أن النتائج التي تم الحصول عليها من المقيمين في متجر قوقل بلاي مرضية نوعاً ما. بالإضافة إلى ذلك، هناك طلب متزايد من أفراد مجتمعنا لإضافة وزارات أخرى إلى التطبيق. ويشجع مجتمعنا تقديم مثل هذه الخدمة التي تعد الأولى من نوعها. وقد وصل التطبيق إلى أكثر من 50 ألف تنزيل في أقل من ستة أشهر، ومتوسط التقييم 4.5 من 5 في متجر قوقل بلاي وقت كتابة هذه الورقة.

الكلمات المفتاحية : تطبيقات الهاتف المحمول، تطبيق الراتب.