Minireview Article

In the Developers' Footsteps of a Mobile App for Soil Monitoring and Protection

ABSTRACT

It is known that mobile applications running on the Android operating system enjoy real appreciation among users around the world. These applications include those dedicated to soil monitoring and protection. Concerning the latter, we propose to discuss, step by step, mainly the phases and stages related to the configuration, design, development, implementation, testing, and validation of a mobile application with valences in the monitoring and protection of soil resources. Moreover, we analyzed from the very beginning and what are the main differences between the three possible work scenarios - native, hybrid, or web mobile application, to see what the requirements and features that we have to take into account in the development of the proposed application. In this sense, the work methodology is specific to the development of software applications, about which the results show us that the optimal option for the considered mobile application is a mix between native and hybrid development. Consequently, as a result of the analysis carried out on the entire development and life cycle of the application, it is found that our proposal for an application dedicated to soil monitoring and protection is more than welcome, the elements related to the configuration, design, development, its implementation, testing and validation being not only the prerogative of developers but also of users and customers.

Keywords: mobile apps, MIT App Inventor®, development cycle, soil monitoring & protection.

1. INTRODUCTION

From 2011 until today, the daily use of the Internet directly from a mobile phone has increased by 504% [1]. In other words, over 4.4 billion people around the world are currently - 2022, constant users of the mobile internet. An impressive number, isn't it? And this is not all. Here's what statistics say about online user behavior:

- over 70% of web traffic is generated from mobile devices (CIODive) [2];
- the average installation rate of a shopping application reached 32.8% in 2020, up from last year when it was 29.8% (Statista) [1];
- 61% of users prefer and trust brands that offer a good mobile experience (HubSpot) [3]. Also regarding mobile data users, the statistics record a significant increase in 2018, and regarding the last years (from the perspective of the pandemic), the numbers are certainly higher already.

Until the next study we know that [4]:

- over 86% of online users in Romania connect via mobile phone;
- the entire percentage of 86% is also attributed to people who use mobile phones for social networks communication (Facebook®, LinkedIn®, Instagram®, TikTok®, etc);
- 43.5% of them frequently shop online on various e-commerce platforms, and the most purchased products for the moment remain fast food, clothing, and sports items; in terms of using the internet for shopping, the average age is between 16-34.

Thus, it is easy to understand that the most powerful tool to develop your business today is by creating and launching a mobile application for your company or department. Made intelligently, such an application can ensure a significant increase in the number of customers, and implicitly in profit [5, 6]. In such a context, we inevitably conclude that the development of a mobile application is a step that companies and developers, regardless of industry and area of interest, must take to stay relevant in the market and/or in sync with user expectations. Before starting such a project, however, it is essential to know what expectations potential customers/users have from the application they will use: modern design, intuitive architecture, personalized experience, frequently updated information, dynamic communication tools - chatbots & live chats, only relevant information and functionality, functionality and features that consume little space and do not require the device's battery, and dynamic and simple processes for Logins and Checkouts. What types of mobile applications can be developed in this sense? Can mobile applications benefit from context-awareness? [7] What development cycle can be implemented for an application dedicated to the soil resources monitoring and protection? How will it look and behave? These are just some of the questions we will try to answer in the following.

2. MATERIAL AND METHODS

To see step by step what are the elements that must be taken into account when we propose to develop a mobile application for the monitoring and protection of soil resources, it is appropriate to first go through the main phases of the life cycle and the development cycle of a software. In the sense of the aforementioned, we are committed to establishing and (re)structuring the development phases strictly from our perspective, as users and then as software developers; although such a process is as complex, dynamic, and time-consuming as possible, the results obtained to support our approach and encourage us to take other, additional steps to achieve the proposed objective and improve the application.

3. RESULTS AND DISCUSSION

To create a mobile application (even for monitoring and protecting soil resources) the product must first be clearly defined [8, 9], therefore one of the most important phases for developers/specialists in creating mobile applications is to understand the demand/request of the customer; this aspect appears more prominently in the development of an IT system or software is carried out from scratch (see Fig. 1), and not through acquisition (see Fig. 2).

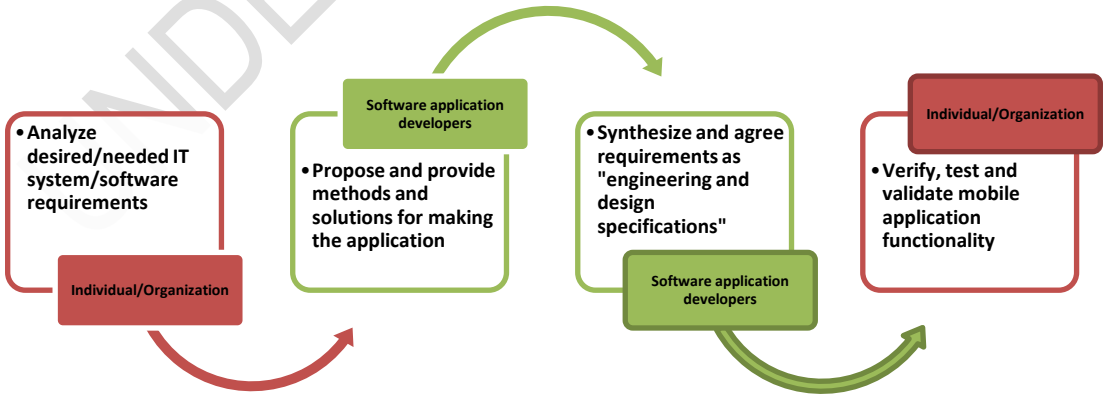

Fig. 1. Development of the mobile application through the realization of software

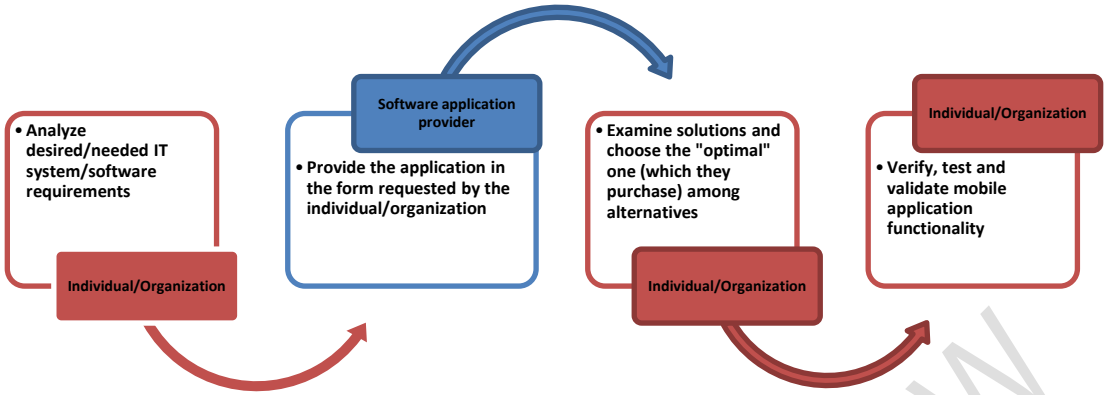

Fig. 2. Development of the mobile application through the purchase of software

Market studies carried out by customers/users are also important when they want to have a truly unique product that responds to and corresponds to all the needs of those who access it. Moreover, the creation of the identity of the application can be based on a presentation site; the mobile app can "borrow" design elements that customers/users are already familiar with (from other similar apps) so that they are encouraged to use the app. In terms of attracting new customers/users, only promotion will be the key to a successful launch.

In a mobile application for soil monitoring and protection, the visual elements such as the choice of eye-pleasing colors, banners and the logo must blend perfectly with the solutions offered by the application itself, through the functionalities. Thus, its realization will involve both design and programming work. By making a mobile application, you can follow both the success of a business and the development of a product that helps the user in what he proposes (monitoring and protection of soil resources). Before we start the process of creating the application, we must take care to understand the user's profile as well as his needs and goals.

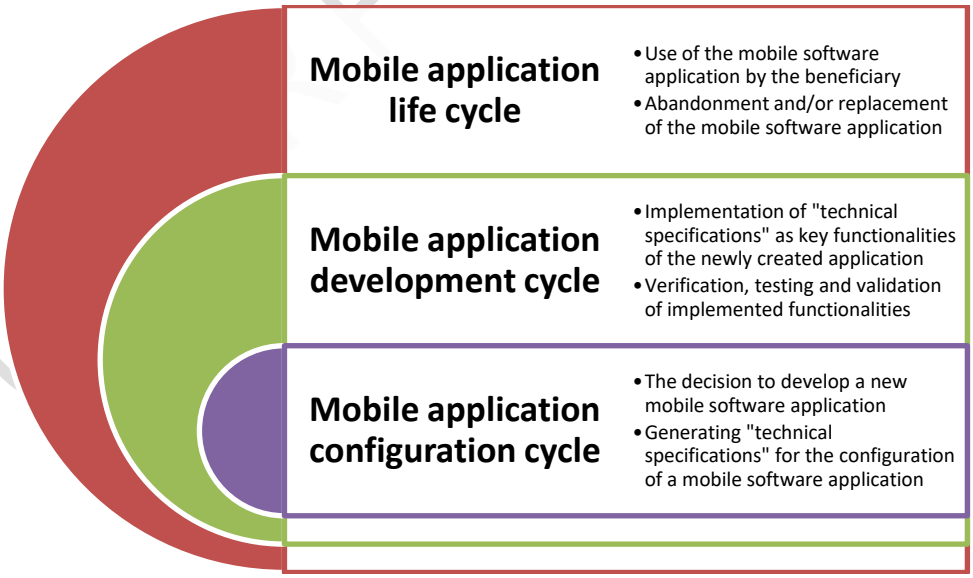

Fig. 3. Life cycle and development diagram of a specific mobile application

As in the case of other applications, for mobile applications dedicated to the monitoring and protection of soil resources, there are a series of steps that we must go through; in the creation of a mobile application, these steps can be defined as implementation phases - what creates the development cycle, integrated into the life cycle of the software application (Fig. 3), among which we mention [11-13]:

- acquiring a good understanding of the product/service that we have to offer to customers (how the application should look, how it should work, what facilities it should offer, etc.);
- identification of the concept attributed to the product/service, which entails establishing the typology of the application (if it is a simple or complex application, if it is easy or more difficult to use due to the existence of several features;
- organizing an action plan that includes activities closely related to the purpose and target of the application, such as scheduling a focus group with niche users;
- identifying (online) users interested in the business object or the idea behind the application, and understanding their needs;
- developing an information architecture, by establishing the data and functionalities that the mobile application needs to include;
- implementation and preparation, which is equivalent to starting a heavy execution work, and which is realized by programming the application;
- the launch cycle that corresponds to establishing the period necessary for the development of the mobile application, preparing the versions for testing, and, implicitly, the launch of the application;
- testing and releasing the version by implementing the results generated from the tests performed by random users, plus the subsequent maintenance activities to obtain the maximum results.

What kind of resources are involved in creating an Android application? The optimal conditions for the development of applications involve, of course, several stages based on the use of certain programs and devices, among which we mention [14-16]:

- a software development kit (SDK), which does exactly what its name says, is a set of tools necessary for the development of an application that corresponds to a specific software, hardware platform, framework, operating system, etc.
- an essential Integrated Development Environment (IDE) program, such as Android Studio®, MIT App Inventor® or Eclipse®, which includes a source code editor, automation, and debugging tools for mobile applications;
- a Java Development Kit (JDK) type program;
- a virtual device for testing the application or an emulator, which allows the programmer to test the application through the computer he is working on.

Because Android® application development activities have become very common among mobile data solutions, new programming methods have been created. Nevertheless, the Java language remains the basis of the tools that allow the creation of mobile applications for Android. In addition, Google has accepted a new method of coding Android applications (or apps), namely Kotlin®.

Table 1. Characteristics of mobile applications to their type (adapted by 10)

Characteristics of mobile applications	Native apps	Hybrid apps	Web apps
Flexibility on operating systems	No	Yes	Yes

Development costs	High	Low	Medium
Time invested in the development	It depends on the complexity		
Maintenance	High	Medium	Medium
Speed	High	Medium	Dependence on the quality of the Internet
Performance	High	Medium	Medium
Offline operation	Yes	Yes	No
Interaction with the device's functionalities	Yes	Partial	No
Programming level	High	Medium	Medium
Adaptation to different types of screens*	High	Medium	Medium
Updates in the application	Frequently	Yes	Always updated
Security-associated risks**	Low	Medium	High

* It refers to the scalability of the work screens of the proposed application;
** It refers to the risks of accessing various personal data specific to users/customers.

As a result of the mentions in Table 1, various types of applications can be developed, each with specific characteristics, advantages, and disadvantages, respectively:

- Native apps - are mobile applications developed for a specific operating system (which means that if an application was developed for Android, it will not be able to be used on iOS. The name "native applications" reflects the fact that they are developed with the particularities of a platform. To access a native application, the user must download it from the store (Apple App Store® for iOS apps / Google Play® for Android), after which an icon will be placed on the phone screen - for quick access (Programming languages: for Android - Java®, Kotlin®, for iOS - Swift® or Objective-C®).
- Hybrid apps - represent a mix between native and web applications. They can be found in the app store, require installation on devices, and can interact with a range of functionality on devices (just like native apps). Typically, hybrid applications are written in HTML5, CSS, and JavaScript and rely on HTML for browser display.
- Web apps - run as web-hosted servers, behave like applications but work like web pages adapted for mobile devices. They are developed on web technologies (HTML, CSS, Javascript, JQuery) and can be accessed without installation.

Each client/user has specific requirements on how an Android mobile application should work, look and behave, but which should also be adapted to the client/user's business or

needs. Therefore, at each stage of the development of the application, the customer's opinion and desire must be taken into account, as follows:

- identification of the necessary resources and analysis - Our team worked with passion in the field of mobile application development for Android, and that is why we pay great attention to the design of the application to be implemented. We take into account factors such as the customer's requirements and needs from the Android mobile application and the functions that the application must fulfill following current technologies;
- mobile application design - The next step is the allocation of resources for the design part. We create the application logic scheme, the basic structure, the graphic design of the mobile application based on the client's requirements, and the complete descriptions that allow a smooth transition to the next step, namely the implementation;
- creation of the Android mobile application - Based on the defined project and the allocated resources, our team of programmers specialized in creating mobile applications initiates the implementation of the Android application. They use modern programming languages and technologies adapted to the latest generation of Android systems. The way our company works is based on team spirit and a long experience in the field of programming and design;
- testing and launching the mobile application - The last step is checking both the functionality of the finished product, but also of each constituent element such as images, texts, animations, transitions, etc. The mobile application will be optimized both in terms of loading time and in terms of interaction with the user.

In the process of creating an Android application, we will take into account all the steps described above. Moreover, of the application intended for the monitoring and protection of soil resources, the design is also an element of interest. When we talk about mobile application development, graphic design occupies an important place in the discussion. We are talking about visual experiences intended for users who tick certain features. They must be: intuitive, easy to use, and interactive. An application should have an attractive design that takes into account both the brand identity and the functionality of the application. In this sense, we are talking about either a simple design, an attractive one, or a customized one.

For many, the idea of simple design does not seem to be too challenging. Many of us like to imagine spaces decorated with various motifs, or information accentuated by vibrant colors for better assimilation. But, when we refer to the creation of a mobile application, we first think about its role and functions and only later about the visual impact on the user. Although applications with a rich graphic design or simply original are attractive, the most used applications come with a simple layout and an intuitive structure. The latter defines the user experience. The paradox is that a simple and effective design is much more difficult to achieve than one based on the freedom of imagination. The simple variant implies a great capacity for synthesis on the part of the designer.

If you are wondering what advantages a mobile application can offer you for your business or company, find out that our mobile application creation or mobile development services have allowed our customers to develop their businesses online as well. You too can benefit from the following:

- accessibility - With the help of a mobile application, your customers and smartphone users can access your products and find out information about them, from any location where there is an Internet connection;
- possibility of customer loyalty - The most suitable tool for customer loyalty and turning your visitors or internet users into potential customers is a mobile application.

An obvious example of this kind is giving promotions or offers to your customers, only through the mobile application;

- business development - The high potential of attracting and retaining customers allows business development and expansion;
- provides support - A mobile application can provide instant help to customers who want information related to the product, want to know the working hours, make an online order or make a reservation to benefit from the services you offer. The possibilities are unlimited and in your favor, especially if you turn to a company with experience in developing mobile applications;
- continuous monitoring - You can be continuously updated with the statistics about the usage of your application. You can find out how many users have downloaded it, how many are using it, and how many people have opened each notification sent by the application, separately.

4. CONCLUSION

The existing soil monitoring and protection mobile applications on the market are mostly designed to provide information about soil characteristics, according to a simple analysis of them. However, many of the considered applications are not fully explained so that the user knows what and how he can use them according to his requirements and needs. In this sense, we consider it auspicious that users can also have access to the ways to create/develop the applications they need.

More than that, we believe that of the two solutions regarding the development of an application, the most profitable is the one related to the development of the application from scratch, and not its purchase. We say this because we believe that the step-by-step development of an application must keep up with the real and concrete needs of users, not just serve them tangentially through a series of pre-implemented functionalities. We are also of the opinion that the most suitable solution for developing an application for the monitoring and protection of soil resources can be folded over the variant of developing hybrid mobile applications, which assume a balance between the flexibility of functionalities and the price-quality ratio.

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