

Original Research Article

Soil Protection and Mobile Apps created with App Inventor[®] - a Multidisciplinary Symbiosis?

ABSTRACT

This paper starts with the definition, descriptive characterization, and synthetic analysis of the MIT App Inventor[®] platform - according to the last 10-12 years users perceptions - thus trying to emphasize the malleability and affinity of the platform with the needs of the digital consumer society. The analysis of how the platform can be implemented in soil protection strategies is performed simultaneously with the configuration and development of a digital field agenda. The application requires the correlation of the MIT App Inventor[®] with soil protection-specific data. The analysis was conducted in the Office of Informatics, between October 2020 and December 2021, and involved identifying and scoring the elements that make the platform to be used to create dedicated soil protection apps. The analysis methodology included the main components of mobile devices that may be related to the collection and processing of field data. As a result of the configuration of the application, it was observed that the MIT App Inventor[®] can be successfully used in modern strategies for soil protection. We recommend those who feel the need to have their application, to use MIT App Inventor[®] because it promises a better integration of soil and computer science.

Keywords: sustainable agriculture; soil protection; MIT App Inventor[®]; mobile apps setup.

1. INTRODUCTION

Since the Stockholm Conference (1972), which laid the groundwork for the United Nations Environment Program (UNEP) - a conference that coincided with the entry of the term «environment» into the international agenda [1] - it has become increasingly evident the fact that both the collection and analysis of environmental data are of vital importance to mankind [2, 3]. As a result of the facilities offered by the new information and communication technologies, in all sectors of society (even in agriculture), phrases such as «information society», «communication society», «information consumption society», etc. were imposed to designate one and the same existential reality [4]; a reality in which access to information and the formation of an information culture prevail [5, 6].

In today's society, defined by the new reality, the success and survival of many companies, or individuals with political, social, economic, or environmental protection responsibilities, depends on their ability to locate, analyze and use information resources efficiently [4, 5]. Moreover, the efficiency to which we refer is directly related to the achievement of the proposed purposes of information, documentation, or knowledge, as well as to the existence of concrete situations for making certain decisions, optimizing some processes, or applying some methodologies in favor of others [6, 7].

No matter what field of science and technology we look at, it is obvious that we are dealing with an amalgam of information unprecedented in human history. Environmental sciences are no exception, and recent advances in this field would have been inconceivable, unmanageable, and unattainable without the support of modern information technology, in

the sense of Environmental Information Systems (EISs) [8, 9], or why not, of Environmental Informatics (EI) [10-12]. In the sense of the above, it can be stated that specialists working in the field of environment or related fields need a large amount of data, information, and knowledge at each stage of management and evaluation of environmental processes [5, 13]. At the same time, to develop a project and implement it, they need to know and understand the conditions under which these processes take place. The analysis performed must be based on the best available data, methods, and techniques, and on the knowledge gained from one's own experience or other specialists [5, 13]. Traditionally, this information and knowledge are obtained, according to current requirements, through direct access to databases, reports, and documents [5, 13], through the transfer of information and knowledge between specialists (managers, practitioners, researchers, teachers, etc), and on the occasion of training courses, workshops, congresses, and other specialized scientific events [14], which most often emphasize the idea of sustainable community development [15, 16], where agricultural practices occupy a significant place.

To improve management and environmental assessment, it is necessary for specialists, and not only, to be able to manage and implement the concepts of environmental monitoring and assessment. This goal can only be achieved through Environmental Information Systems and the full knowledge and understanding of the dynamics of socio-ecological systems [17]. As such, they must have easy and efficient access to up-to-date information and knowledge (in the form of big open-access data) [18], enabling them to make the best decisions for sustainable development, both for developed economies and those under development.

The practice of gathering documents of any kind into collections and further researching their contents has existed for a very long time and is seen as an almost natural feature of humanity on its way to the formation of a culture. Our concern cannot be missing from this, about the implications of Environmental Information Systems and Environmental Informatics in soil protection [19-21]. Romania is known for the fact that the activity of soil protection through the prism of the tools offered by Environmental Information Systems is just beginning and that it requires an approach that is both complex and multidisciplinary, we tried to fill these gaps through this research. The potential beneficiaries of the structured information during this research project are the students and teachers from the environmental engineering departments of the country's universities, engineers, computer scientists, and auxiliary staff involved in specific soil protection activities. This paper starts with the definition, descriptive characterization, and synthetic analysis of the App Inventor[®] platform under the development of the Massachusetts Institute of Technology (MIT) - according to users' perceptions from the literature of the last 10-12 years - thus trying to emphasize the malleability and affinity of the platform about the needs and demands of the digital consumer society.

2. MATERIAL AND METHODS

The analysis of how the MIT App Inventor[®] platform can be integrated into modern soil protection strategies is done simultaneously with the configuration and development of a field-like digital application. The application requires the correlation of the MIT App Inventor[®] platform with specific data for soil protection (with the variation of texture, temperature, altitude and relief, relative humidity and atmospheric pressure, dynamics of local hydrometeorological characteristics, etc).

The analysis was performed at the Office of Informatics within the North University Center of Baia Mare - Cluj-Napoca Technical University (Romania), during the reference period October 2020 to December 2021, and involved identifying and scoring elements that make MIT App Inventor[®] be used to create dedicated soil protection applications. The analysis

methodology included the main components of mobile devices that may be related to the acquisition and processing of field data about soils (camera and video camera, image picker, player, sound recording, navigation and map, barometer and hydrometer, accelerometer, orientation sensor, thermometer and light sensor, etc).

As a result of the configuration and pre-testing of the alternative application to the field agenda, it was observed that the MIT App Inventor[®] platform can be used successfully in modern environmental impact assessment strategies, but especially in monitoring and protection. soils. In this way, we recommend to those who want and feel the need to have their application for soil or environmental protection, to use MIT App Inventor[®], because it is a free tool, of real/practical use, which promises a better integration of the two areas of interest, namely computer science and soil science.

3. RESULTS AND DISCUSSION

3.1 Digital consumer culture and the MIT App Inventor[®] platform

Our consumer culture of digital content offers us all kinds of applications and opportunities for entertainment, pleasure, and sometimes even learning. However, in general, these are passive activities (see Fig. 1) [22-24]. In addition to the attractiveness of consumption, there is also the satisfaction of producing, that is, of creating content or applications. It is the joy and pride that results when we paint, build a model or make a fully functional mobile application [25,26]. The high-tech mobile objects (mobile phones, tablets, laptops, etc.) that we use today to consume entertainment and access information are black boxes for most of us. Their operation is incomprehensible, and while there are capabilities in some of them that allow the user to draw images, make videos, or generate new content, they are not, in and of themselves, creative environments.

In other words, most people cannot create applications running on these gadgets [25,26]. In the sense of the above, what if we could change that? What if, for example, we could take creative control of our everyday gadgets, such as mobile phones or tablets? What if creating a mobile phone app was as easy as taking a picture or playing games? Developing a successful mobile application that reflects the idea of a content creator and addresses the needs of your target audience is not an overnight task. It takes a lot of effort and a significant amount of time to build an Android or iOS app [27-29].

Most people believe that mobile application development means choosing the right technology and hiring a reputable mobile application development company. However, keeping track of the proper mobile app development process from start to finish is just as essential to making apps for the PlayStore[®] or App Store[®]. First, it could demystify those objects. Instead of being black boxes, impenetrable to our vision and creativity, they become objects with which new content can be modified and generated. They thus become objects capable of our understanding. We get a less passive and creative relationship with them and we get to play with these devices in a much deeper and more meaningful way when we can build applications for each of us [25]. The unique motivational power that mobile phones could have in education is also shown through the MIT App Inventor[®], which can turn students from consumers into creators.

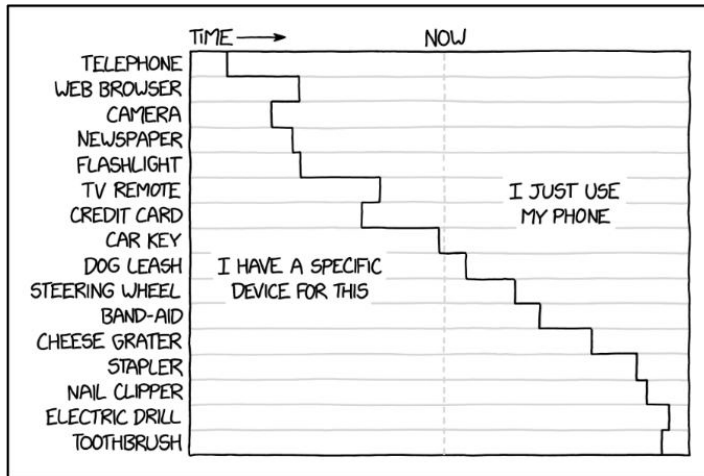


Fig. 1. A look at the current features of mobile phones

After reading this revealing fact, most people would be wondering about the stages involved in developing a mobile app. The mobile application development process begins with market research, wireframing, technical feasibility assessment, prototyping, design, development, testing, and launching. Application promotion, support, and maintenance are what follow. It's not an overnight pregnancy; even an experienced and qualified developer must pay attention at every stage to ensure the sound and functionality of the sound of the developed application. In the following, it is provided the complete stages of the mobile app development process that can guide users through the application development journey:

- Market research - you may already have a lot of ideas for your mobile app; however, it's a good idea to do more research on demographics, behavior patterns, and target audience demand. The other important thing that covers this phase of the mobile app development process is not to overlook your competitors. By researching thoroughly, you get answers to the following questions: Who is your target audience ?, What will be the right platform to launch your app What do your competitors offer your customers? These are just a few questions from the long list that you need to keep in mind. Giving enough time for market research will build a solid foundation for mobile application development.
- Wireframing - provides a clear understanding of the features and functionality of the application and is, therefore, a crucial step. Wireframing helps to narrow down ideas and organize all the components of the application correctly. At this stage, users try to identify how the planned features will blend into a fully functional mobile app. The main focus should be on providing an excellent user experience by creating and simplifying the script, to demonstrate how to use and explore the application.
- Technical feasibility assessment - is the phase in which it is verified whether the backend system would be able to support the functionality of the application or not. Users need to understand that an application with different formats and platforms will not have the same needs. By the end of this step, creators and users will have various ideas for the application's functionality.
- Prototyping - helps the creator determine if they are moving in the right direction or not. Therefore, a prototype is created that conveys the concept of the application to the target audience to verify how it works.

- In the design stage, UI (User Interface) and UX (User Experience) are perceived as two vital components of the mobile application (see Fig. 2). The former is responsible for the appearance and attractiveness of the application, while the latter facilitates the interaction between design elements.



Fig. 2. A perspective on mobile applications design

- The mobile app development phase begins as soon as the creator needs to develop a prototype to authenticate the features and functionality. The development phase is further divided into different sections, in which the team or a developer writes pieces of code, which are then tested by another team. After marking the first section as error-free, the development team moves on. In the case of complex projects with changing user requirements, it is good to opt for an agile methodology, which leads to progressive development and brings flexibility to the planning process.
- Early and frequent testing give developers the advantage of fixing an error as soon as it occurs. Also, when testing the application, consider compatibility, security, usability, performance, UI checks, and other factors. Check if the application serves its purpose or not. To test the app in real-time, you can ask a few users to use the app and give feedback. Once users appreciate the app, you can be sure of its functionality.
- Implementing the application is not the last technical step, as you receive feedback from your audience, and therefore you need to make changes accordingly. The other two mobile application development processes that remain associated with a mobile application are support and maintenance. It would not be wrong to say that mobile app development is a long-term commitment rather than a short-term project.

In line with the phases of mobile application development, presented earlier, over the years, there have been many attempts to simplify the software development process and allow more people to develop applications. MIT App Inventor[®] is another tool that can bring software development to the masses, rather than being in the hands of a small number of professionals [23, 26].

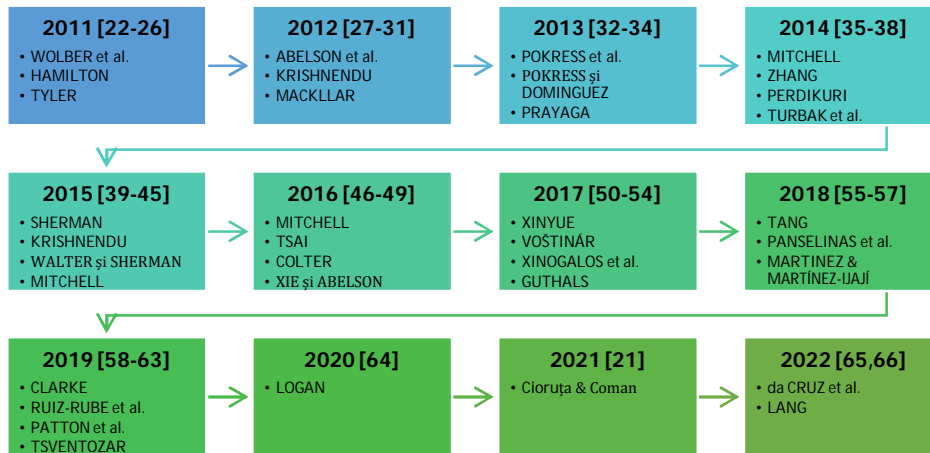


Fig. 3. Examples of publications that support the usefulness of the MIT App Inventor®

Mobile phones programming can provide an authentic and captivating hook in computer science, but also in other applied sciences (ecology, pedology, agriculture, etc). With MIT App Inventor® programming Android apps are as easy as clicking blocks together. The MIT App Inventor® has been used successfully (see Fig. 3) in after-school learning programs, summer camps and schools, experimental workshops for teachers, and dedicated programs in classrooms from high school to college [22].

Over time, the MIT App Inventor® development environment has been defined in the scientific literature of the last 10-12 years as:

- “(...) a Google Labs® project that uses block editor technology and a drag-and-drop interface to enable users to create applications” [23];
- “(...) a visual language based on simple blocks of programming that users can drag and drop to create applications” [24];
- “(...) a new visual, drag-and-drop programming tool for building mobile applications on the Android platform” [25];
- “(...) a language of visual blocks for creating mobile applications, as part of a Google® pilot program, in a core curriculum at the University of San Francisco” [26];
- “(...) a visual programming environment developed by Google® and now available free of charge from the MIT Mobile Learning Center®, which allows students without prior programming training to create applications for Android mobile devices” [27];
- “(...) a language of visual blocks for building mobile applications; like Scratch®, the interface of language drag-and-drop blocks significantly reduces the entry barrier - beginners can immediately build applications that interact with mobile technology and create applications that have a real global impact” [28, 29];
- “(...) the latest visual block programming language designed to introduce students to programming by creating mobile applications” [30];
- “(...) a new programming environment that allows novice programmers to build apps for Android mobile devices” [31];
- “(...) a visual drag-and-drop programming tool for designing and building fully functional mobile applications for Android” [32];
- “(...) a block-based visual programming language that makes sophisticated computing concepts accessible to a wide range of students” [33];
- “(...) a fun and intuitive visual programming environment that allows users to quickly and easily create applications that will run on the Android platform” [34];

- “(...) the fastest and easiest way to create custom Android apps (...) even if you have no previous programming experience; (...) can be used for personal, business, and commercial applications - even applications to be sold in the Play Store[®]” [35];
- “(...) a project inspired by MIT Media Lab's Scratch Development System[®]” [35];
- “(...) a visual programming environment for creating applications for Android-based smartphones and tablets. It is an alternative programming platform, quite easy, but also powerful, because it allows the development of applications using databases, interactive maps, and other advanced concepts and, most importantly, you do not have to write code” [36];
- “(...) a block-based language for specifying the behavior of mobile applications; its naming features (involving parameters and procedures, global and local variables, and names for procedures, components, and component properties) have been designed to address naming issues in other block languages” [37];
- “(...) an open-source code-free platform for application development using the drag-and-drop approach; provides an easy environment for non-programmers to create a mobile application” [38];
- “(...) a visual drag-and-drop programming for designing and building fully functional mobile applications for Android” and “an open-source web application originally provided by Google[®] and now maintained by the MIT[®]” [39];
- “(...) a mobile-based live development environment” [40];
- “(...) a quick way to create custom Android apps for smartphones or tablets” [41];
- “(...) the software development system running in your browser to create applications running on your smartphone and tablet” [42];
- “(...) a visual block language that allows beginners and non-programmers to create applications for their phones and tablets. It has allowed thousands of people to create useful software in the real world and to see themselves as creators rather than just consumers in the mobile computing environment” [43];
- “(...) one of the most popular block-based programming environments” [44];
- “(...) a programming environment that reduces barriers to the creation of mobile applications for Android devices, especially for people with little or no programming experience. App Inventor applications for a mobile device are built by arranging components with a WYSIWYG editor in a web browser, where the development computer is connected to the device via WiFi or USB” [45];
- “(...) a visual language that allows users to create mobile apps for Android” [46];
- “(...) a quick and easy way to develop Android applications” [47];
- “(...) an easy-to-use tool for building both simple and complex Android applications that can be easily ported to your phone, shared with others, or even sent to the Google Play Store[®] for distribution on all Android devices in the whole world” [48];
- “(...) a programming language for Android apps designed to teach programming skills to middle and high school students” [49];
- “(...) an innovative tool, developed by Google[®] and maintained today by the MIT[®]; with it, you can create applications for Android mobile devices, through a visual language, without having to decorate or write programming language codes (...) an excellent learning tool that allows newcomers to computer programming to create complete applications” [50];
- “(...) a free online programming tool that uses simple block-style language that makes coding easy to learn” [51];
- “(...) a web-based visual platform for building Android applications” [52];
- “(...) a visual language, blocks for building Android applications, (...) which has tools for creating user interfaces and blocks, which collide and define how the application will work” [53];

- “(...) an informal online learning environment with over 5 million users and 15.9 million applications created” and “(...) an environment that uses block-based visual language to enable people to create mobile applications for Android devices” [54];
- “(...) a block-based programming environment that sets a «low stage» to allow creative creation of applications, while involving students in complex computational thinking activities (procedural abstraction and data, iterative and recursive thinking, structured breakdown of tasks, conditional and logical thinking and debugging)” and “(...) a visual programming environment that uses Scratch-like code to build Android mobile applications” [55];
- “(...) a mobile application development platform that aims to democratize the construction of mobile applications by making application development accessible to people with little or no experience in script-based programming” [56];
- “(...) a visual programming environment that is similar to Scratch[®] and Alice[®], which focuses more on mobile application development” and “(...) a block-based cloud programming tool that allows everyone to fully develop applications functional for Android devices” [57];
- “(...) a block-based open-source programming tool that allows users with no previous programming experience to create applications specifically for smartphones and mobile devices” [58];
- “(...) an online tool for creating mobile applications for the Android operating system; with this tool, it is possible to program applications without having to learn a programming language, an excellent approach that must be introduced in the development of applications” [59];
- “(...) an easy and visual application that allows you to develop Android applications even if you do not have programming knowledge” [60];
- “(...) a powerful programming environment, accessible to all” [61];
- “(...) a block-based mobile development tool” [62];
- “(...) an online platform designed to teach concepts of computational thinking through the development of mobile applications” [63];
- “(...) a free online visual programming environment, developed by Google[®] and now maintained by the MIT[®]; it allows people to create software for their phones and tablets, rather than just using those devices” [64];
- “(...) an online visual environment that uses the blockchain programming paradigm, which allows even users unfamiliar with programming languages to quickly develop mobile applications running the Android operating system” [65];
- “(...) a free and revolutionary online program from MIT[®] that allows you to create your mobile apps” and “(...) matching easy-to-use code blocks allow even beginners to quickly create apps work” [66].

In the sense of the above, we define the MIT App Inventor[®] platform as “a new visual drag-and-drop programming tool/environment or informal web-based platform that allows users - non-programmers, beginners, or novice programmers - to create applications for Android mobile devices”.

3.2 MIT App Inventor[®] and its soil protection features

Nowadays, digitalization and mobile technology are obvious elements in most activities. Regardless of the area of expertise and/or areas of interest of a professional, it is important to know not only the basic functionality and interfaces of devices but also the basics principles of computing [65]. Block-based visual programming environments such as Scratch[®] or App Inventor[®] are typically used to teach computer science to beginners and non-computer users (see Fig. 4), alike by practicing with fully functional applications.

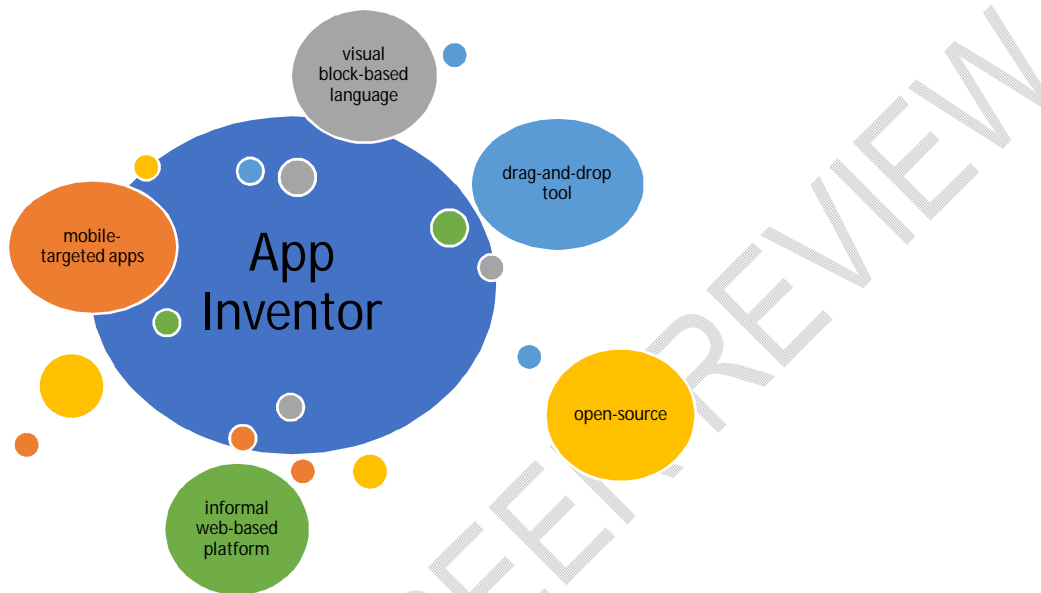


Fig. 4. The top 5 defining elements of the MIT App Inventor[®]

The value of the App Inventor[®] may seem questionable to a professional developer with years of experience in Java. Why use App Inventor[®]? It gives us the ability to understand the challenges creators and users face and gives a context to help future software developers take the next step. If you're working professionally with Java or Android, it's only a matter of time before you're approached with a demo or prototype developed with App Inventor[®].

The MIT App Inventor[®] is available for free for anyone to use. It runs online (instead of directly on your computer) and is accessible from any browser. You don't even need a phone to use it: you can test your apps on an included Android emulator. MIT App Inventor[®] applications are created using components. The latter allows applications to use the built-in features of the mobile device (such as camera, microphone, a location sensor, etc.) or web services. MIT App Inventor[®] includes a large collection of components, to which the platform development team adds new capabilities to the system by implementing new components (see Fig. 5).

There have been many requests to include additional features in the MIT App Inventor[®]. Anyone can use the MIT App Inventor[®] platform to implement their components, but so far the only way to make them available to others has been to include them in private versions of the application that are hosted and managed individually.

In this regard, to support those with concrete concerns regarding soil protection (practicing ecologists, farmers, agricultural area managers, etc.) we set out to expose several application development environments for mobile devices (App Inventor® & Bridge to Java®), along with an app created in these environments.

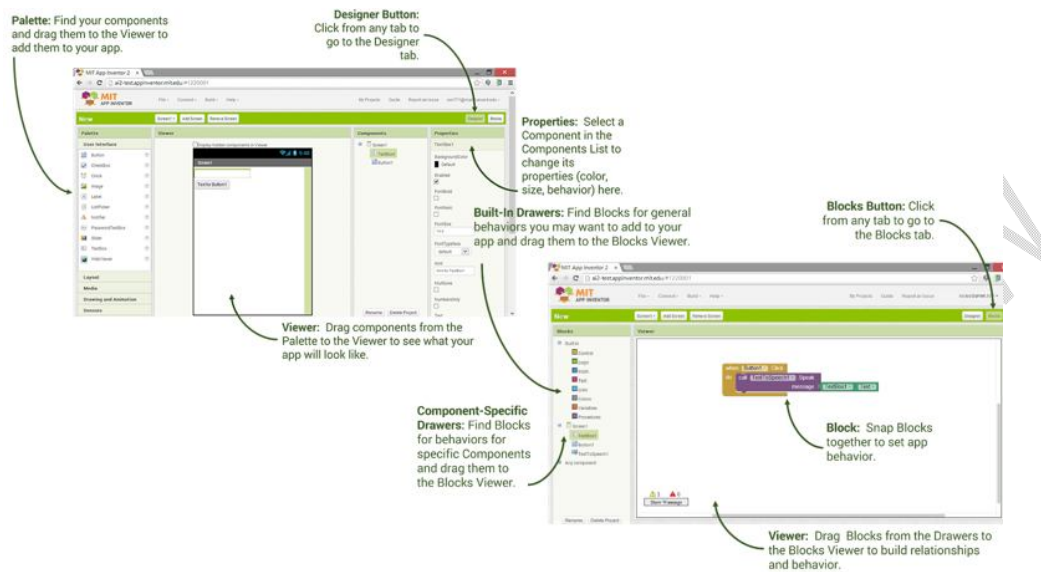


Fig. 5. Description of App Inventor® specific screens: Designer and Blocks Editor

It was also necessary to consult the specialized literature for the functionalities related to the "characterization of the relief-climate-vegetation units" (Table 1 & 2). Thus, applications necessary for the zonal characterization of the sites were created, and validated, through the ecopedological indicators selected from the "Methodology of elaboration of pedological studies" published in 1987, with subsequent amendments.

Table 1. Main characteristics of climatic zones (reproduction with changes, [67])

| Climatic zone | Average annual temperature, (°C) | Solar radiation, kcal/cm ² | $\Sigma T(^{\circ}C) > 0^{\circ}C$ $\Sigma T(^{\circ}C) > 10^{\circ}C$ | Average annual rainfall, mm | Average precipitation IV-X, mm |
|-----------------------------------|----------------------------------|---------------------------------------|---|-----------------------------|--------------------------------|
| Warm-Dry zone | 10.5-11.5 | 124-132 | 4100-4400 3500-3600 | 400-600 | 150-330 |
| Moderately warm and semi-dry zone | 8.0-10.5 | 114-128 | 3400-4100 2800-3500 | 450-700 | 325-475 |
| Cool-Wet zone | 5.0-9.0 | 110-117 | 2900-3500 2400-3000 | 550-800 | 380-560 |
| Very wet and cold zone | -2.0-6.0 | <110 | <2900 <2400 | 800-1400 | >560 |

The ecopedological indicators were elaborated on and improved with the results of recent research. They are intended to ensure a uniform framework, as well as a uniform and systematic recording and presentation of field observations on soils. The application proposed for use captures several work screens, each of which has specific functionalities, which flow from the main screen (Fig. 6). The first feature of the application is the automatic completion of a "soil sampling sheet" (Fig. 7). To this facility are added "procedures for field

recognition of soil texture" (Fig. 8), "determination of soil texture in laboratories of pedology/agrochemistry", and "characterization of relief-climate-vegetation units" by ecopedological indicators selected from the Methodology of pedological studies.

Table 2. Characteristics of the relief categories (reproduction with modifications, [67])

| Symbol | Designation | Characteristic | | | Correlation with the main relief forms |
|--------|--------------------------------|----------------------|-----------------------|-------------------------------------|---|
| | | predominant slope, % | fragmentation density | relief energy, m | |
| L | Meadow relief (alluvial plain) | <1 | extremely weak | <10 | Meadow, wandering plain, coastal plain |
| S | Plain relief | <2(3) | very weak | 10-50 frec. 10-25 local 50-80 | Plain (including terrace), plateau and foothills, unfragmented or slightly fragmented |
| O | Wavy relief | 2(3)-5(8) | weak | 50-150 | Plain (including terrace), plateau and foothills, poorly fragmented |
| C | Slightly rugged terrain | 5(8)-12(18) | moderate | 150-300 | Moderately fragmented hill, plateau, and foothills |
| D | Moderately rugged terrain | 12(18)-20(30) | strong | 300-500 | Highly fragmented hill, plateau, and foothills |
| M | Strongly rugged terrain | >20(30) | very strong | >500 | Mountain |

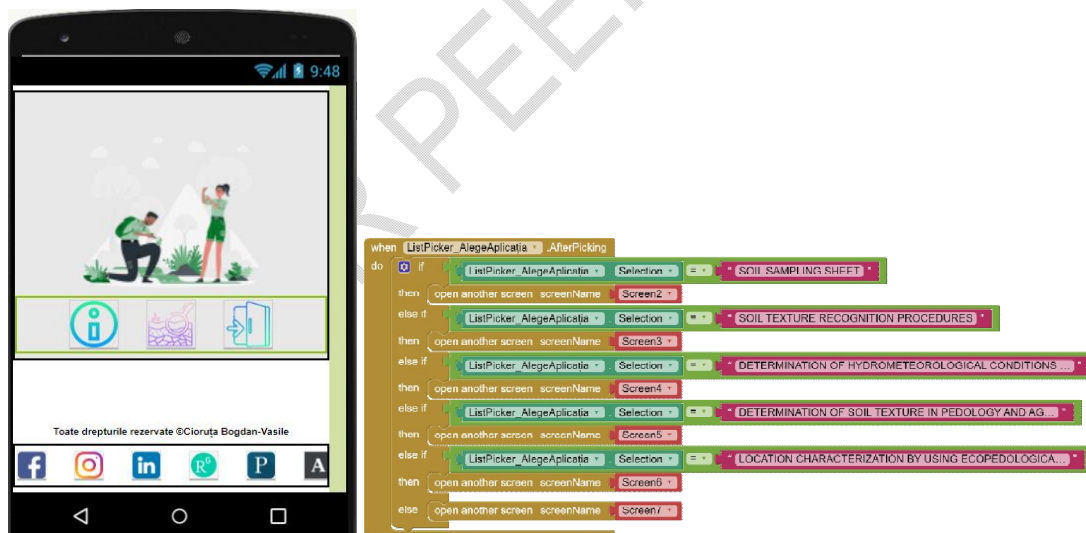


Fig. 6. The main screen of the created application:

- the application interface in App Inventor®;
- the source code of the application interface in App Inventor - Bridge to Java®

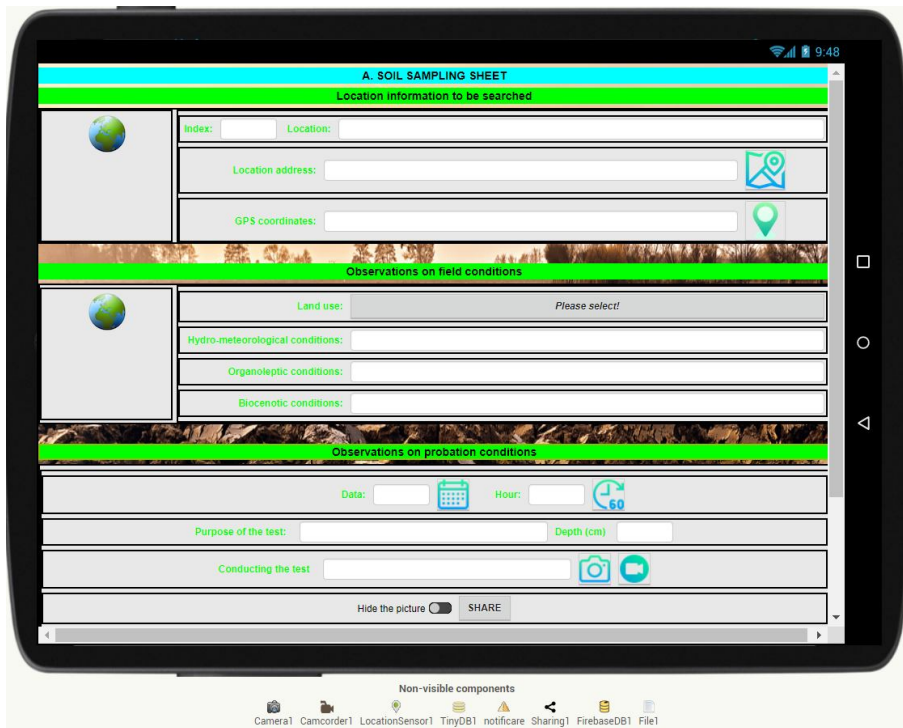


Fig. 7. The Soil Sampling Sheet screen of the created application in MIT App Inventor®

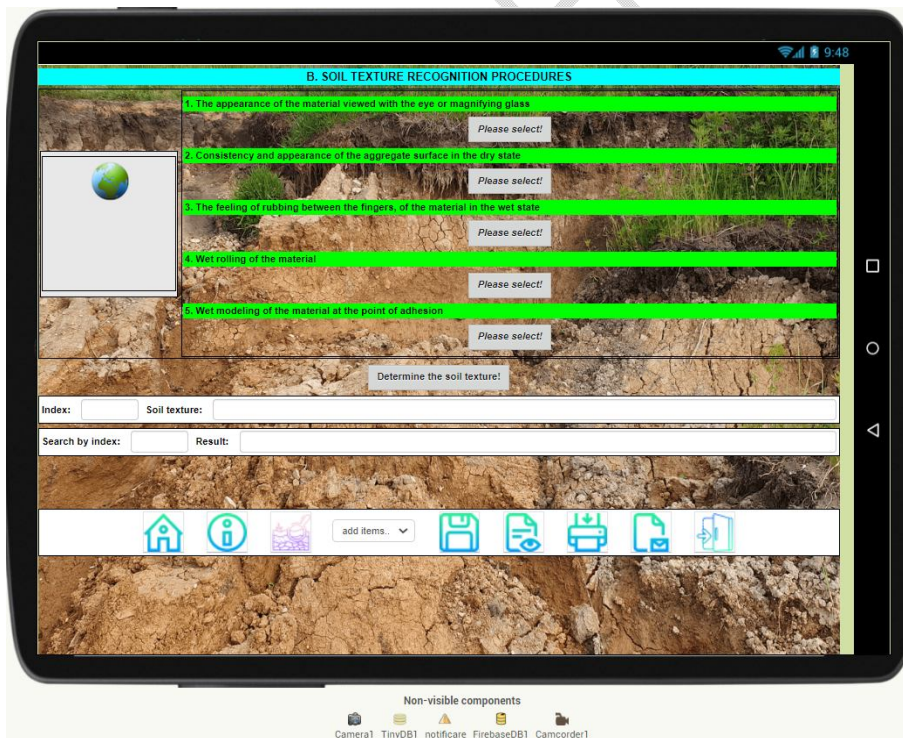


Fig. 8. The Soil Texture Recognition Procedures screen of the created application in MIT App Inventor®

The following describes the components that can be used in the MIT App Inventor® to create mobile applications for soil monitoring and protection (see Fig. 6 and 7). Each component can have methods, events, and properties. Most properties can be modified by applications - these properties have blocks that you can use to get and set values (see Table 3). Some properties cannot be changed by applications - they only have blocks that can be used to get values, not to set them (see Table 4).

Table 3. User Interface components: typology, features, and functionalities to the soil monitoring and protection activities

| Components | Properties | Soil monitoring and protection activities | | |
|------------------|--|---|---------------------------------------|----------------------|
| | | soil classification | determination of specific properties* | other observations** |
| Button | Its properties can be changed in the Designer or the Blocks Editor. | xx | xxx | x |
| CheckBox | | x | x | x |
| DatePicker | A button that allows the user to select a date on the Gregorian Calendar. | x | xx | x |
| Image | Its properties can be changed in the Designer or the Blocks Editor. | xx | xxx | xx |
| Label | | xx | xxx | xx |
| ListPicker | A button that displays a list of texts for the user to choose among. | xx | xxx | x |
| ListView | A component that displays a list of text and image elements. | xx | xx | x |
| Notifier | A component that displays alert messages. | x | xx | xx |
| Password TextBox | Users enter passwords in a component that hides the text. | x | x | x |
| Screen | A component that contains all other components. | x | xxx | xx |
| Slider | A Slider is a progress bar that adds a draggable thumb. | x | xx | xx |
| Spinner | A Spinner component displays a dialog with a list of elements. | x | x | x |
| Switch | A Switch component raises an event when the user taps it to toggle between states. | x | xx | xx |
| TextBox | Text boxes are usually used with the Button component. | x | xxx | xx |
| TimePicker | A button that opens a dialog to allow the user to select a time. | x | xx | xx |
| WebView | Component for viewing Web pages. | x | xx | xx |

* soil texture, color, density, humidity, temperature, etc; ** local conditions (weather, relief, etc), or other conditions which require access and connection to external devices and additional sensors

The application considered for implementation is based on the idea of supplementing the field agenda for noting the observations on soil characteristics, its design resonating with some of the aspects pursued in the user's work (small farmer, ecologist, pedologist, student practitioner, etc). The application in the current version (only by design) is not of interest in the way it does not provide any results; as such, a specific set of instructions must be defined for each component of the interface, in the light of the block editor, which will finalize the behavior of the application.

Table 4. Media and sensor components: typology, features, and functionalities to the soil monitoring and protection activities

| Components | Properties | Soil monitoring and protection activities | | |
|----------------------|---|---|---------------------------------------|----------------------|
| | | soil classification | determination of specific properties* | other observations** |
| Camcorder | A component to record a video using the device's camcorder. | xx | xx | x |
| Camera | Use a camera component to take a picture. | xx | xxx | x |
| ImagePicker | A special-purpose button. | xx | xx | x |
| Player | A multimedia component that plays audio and controls phone vibration. | ? | x | x |
| Sound | | ? | x | x |
| SoundRecorder | A multimedia component that records audio. | ? | x | ? |
| Speech Recognizer | Use a SpeechRecognizer component to listen to the user speaking and convert the spoken sound into text. | ? | x | x |
| TextToSpeech | Its properties can be changed in the Designer or the Blocks Editor. | x | x | x |
| VideoPlayer | | xx | xx | x |
| Yandex Translate | | x | x | x |
| Accelerometer Sensor | A component that detects shaking and measures acceleration in 3 dimensions. | ? | x | x |
| Barcode Scanner | - | ? | ? | ? |
| Barometer | - | ? | xx | xx |
| Clock | - | ? | x | ? |
| Gyroscope Sensor | - | ? | x | ? |
| Hygrometer | - | ? | x | x |
| LightSensor | - | x | x | ? |
| Location Sensor | A component that provides the device's location, using GPS if available. | xx | xxx | xx |
| Magnetic FieldSensor | - | ? | ? | ? |
| NearField | - | ? | ? | ? |
| Orientation | A component that determines the phone's spatial | x | xx | x |

| Sensor | orientation | | | |
|------------------|---|---|----|---|
| Pedometer | This component keeps a count of steps using the accelerometer. | ? | xx | x |
| Proximity Sensor | A component that can measure the proximity of an object (in cm) relative to the view screen of a device | ? | ? | ? |
| Thermometer | - | ? | x | x |

* soil texture, color, density, humidity, temperature, etc; ** local conditions (weather, relief, etc), or other conditions which require access and connection to external devices and additional sensors

4. CONCLUSION

Soil monitoring and protection, as well as field activities carried out by specialists or staff with concerns in the field, are elements that require an integrated approach, which cannot lack the mobile technological component. At the same time, the incursion of the latter must be carried out with equipment that allows a more efficient control in the acquisition, processing, storage, and dissemination of information on soils (from a simple picture to determine the texture and color of soils to specific aspects, nuance, field conditions, and soil classification).

As a result of consulting the literature (especially from the last 10-12 years), we were able to see that there is a historical framework, well nuanced, of concerns for monitoring and protection of soils through mobile devices and associated software. In the last category, we took the MIT App Inventor[®] platform as an example - for the development of Android and iOS mobile applications, to analyze and observe how it can be integrated into soil protection strategies. Thus, starting from the components it makes available (although we only chose the ones related to the user interface and the media), we set out to explore the functionalities that mobile application development platforms assign to mobile applications.

The research results (starting from the premise of using the MIT App Inventor[®] platform in soil protection) have shown that there is a well-defined set of components, features, and sensors that can be integrated into mobile device-specific applications to assist in soil monitoring and protection. Consequently, mobile devices can be seen and used as a means of acquiring, storing, and disseminating data, information, and knowledge on land, land use, and the practice of systematic farming.

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