



ArcGIS in Action: Developing Applications with an Innovative Platform

NASCIMENTO, Caroline⁽¹⁾; MELO, Jamilly⁽²⁾; FERREIRA, Aida⁽³⁾; BARBOSA, Ioná⁽⁴⁾; CARVALHO, Vânia⁽⁵⁾

⁽¹⁾ 0000-0002-6248-005X; Federal Institute of Education, Science and Technology of Pernambuco (*Instituto Federal de Educação, Ciência e Tecnologia de Pernambuco*), Recife, Pernambuco, Brazil. Email: cmn@discente.ifpe.edu.br.

⁽²⁾ 0009-0000-5023-9966; Federal Institute of Education, Science and Technology of Pernambuco (*Instituto Federal de Educação, Ciência e Tecnologia de Pernambuco*), Recife, Pernambuco, Brazil. Email: jbm2@discente.ifpe.edu.br.

⁽³⁾ 0000-0002-0322-6801; Federal Institute of Education, Science and Technology of Pernambuco (*Instituto Federal de Educação, Ciência e Tecnologia de Pernambuco*), Recife, Pernambuco, Brazil. Email: aidaferreira@recife.ifpe.edu.br.

⁽⁴⁾ 0000-0002-5795-1398; Federal Institute of Education, Science and Technology of Pernambuco (*Instituto Federal de Educação, Ciência e Tecnologia de Pernambuco*), Recife, Pernambuco, Brazil. Email: ionarameh@recife.ifpe.edu.br.

⁽⁵⁾ 0000-0002-8849-7095; Instituto Federal de Educação, Ciência e Tecnologia de Pernambuco, Recife, Pernambuco, Brazil. Email: vaniacarvalho@recife.ifpe.edu.br.

The content expressed in this article is the sole responsibility of its authors.

ABSTRACT

Constant technological progress has generated a growing need to acquire and consume new applications and it is this pursuit that has driven the demand for more efficient methods of development. Low-code is a rapid application development approach that allows for automated code generation through visual building blocks. ArcGIS Experience Builder is a powerful low-code tool for creating geospatial experiences. Survey123 is a tool that is also part of ArcGIS, designed specifically for creating custom forms. Sigabem is a project that aims to help people with disabilities access public transportation in the Metropolitan Region of Recife. To carry out this work, the students used both tools, taking advantage of their resources, to develop the two systems proposed for the project. Through what was made available, it was possible to achieve the idealized requirements and develop the necessary functionalities for the design of the applications. It became clear that the features of the ArcGIS platform contained a lot of value and contributed to the application development process. It is also expected to test the implemented functionalities with possible real users of both systems, making improvements as necessary in order to improve what has been developed so far.

RESUMO

O progresso tecnológico constante gerou uma crescente necessidade de adquirir e consumir novas aplicações e foi essa busca que impulsionou a demanda por métodos mais eficientes de desenvolvimento. Low-code é uma abordagem de desenvolvimento rápido de aplicativos, que permite a geração automatizada de código por meio de blocos de construção visuais. O ArcGIS Experience Builder é uma poderosa ferramenta low-code para a criação de experiências geoespaciais. O Survey123 é uma ferramenta também integrante do ArcGIS, projetada especificamente para a criação de formulários personalizados. O Sigabem é um projeto que visa auxiliar as pessoas com deficiências no acesso ao transporte público na Região Metropolitana de Recife. Para a concretização desse trabalho, os estudantes utilizaram ambas ferramentas citadas, aproveitando seus recursos, para desenvolver os dois sistemas propostos para o projeto. Através do que foi disponibilizado, foi possível atingir os requisitos idealizados e desenvolver as funcionalidades necessárias para a concepção das aplicações. Tornou-se notório que os recursos da plataforma ArcGIS continham muito valor e colaboraram para o processo de desenvolvimento das aplicações. É esperado ainda o teste das funcionalidades implementadas com possíveis usuários reais de ambos os sistemas, realizando melhorias conforme for necessário com o propósito de aperfeiçoar o que foi desenvolvido até então.

INFORMAÇÕES DO ARTIGO

Histórico do Artigo:

Submetido: 10/20/2023

Aprovado: 03/05/2024

Publicação: 03/15/2024



Keywords:

Public Management,
Assistive Technology,
Low-code.

Palavras-Chave:

Gestão pública,
Tecnologia assistiva,
Low-code.

Introduction

The internet has brought about a revolutionary transformation in the human trajectory, enabling an innovative way to establish connections with individuals and access the flow of information. These data are significant not only because they are in people's lives, but because they become input for public and social practices focused on individuals (FROHMANN, 1995). So, everyday life has undergone a symbolic change thanks to the efficient and intelligent opportunities that the internet has provided. Constant technological progress has generated a growing need to acquire and consume new applications and it is this pursuit that has driven the demand for more efficient methods of development. It was increasingly necessary to create applications in an agile way, without relying exclusively on highly specialized programmers. As a result, low-code tools have emerged as a solution to meet this high demand for faster and more affordable software development solutions.

Low-code is a method of rapid application development that allows for automated code generation through visual building blocks. This term is notable, mainly, for its high-level approach, use of visual representations, and languages that allow the creation of applications faster and more cost-effectively than conventional development methods (Alves & Alcalá 2022). According to Sahay et al. (2020), one of the main objectives of this paradigm is to deal with the low supply of advanced developers in the labor market. Professionals who do not necessarily have experience with programming can have training in the tool based on proposing low-code development and, thus, already become qualified to create solutions for the industry in a relatively short space of time (Horváth et al., 2020).

Therefore, the concept behind tools with this approach is to allow users with little or no programming experience to create complex applications and systems using an intuitive visual interface. Users are allowed to drag and drop pre-built components and define application logic through settings and rules, rather than writing code traditionally. This significantly speeds up the development process, as it eliminates the need to write each line of code from scratch. It makes it possible for the developer not to waste time with coding and to emphasize other issues such as functionalities and user experience. Thus, there are gains in value generation and strategies for the project (Alves & Alcalá 2022). They also offer features such as data integration, process automation, simplified deployment across multiple platforms, and the inclusion of collaboration features that allow development teams to work together more productively. Thus, it becomes evident why we chose this approach to move forward with the work, given that we would not have enough time due to the duration of the project to master and apply more conventional development techniques and languages.

Sigabem Project

The Sigabem project is an initiative that has the partnership of the State Agency for Information Technology (*Agência Estadual de Tecnologia da Informação - ATI*), the Greater Recife Consortium (*Consórcio Grande Recife - CTM*) and the Federal Institute of Pernambuco (*Instituto Federal de Pernambuco - IFPE*). It is a project that aims to help people with disabilities access public transportation in the Metropolitan Region of Recife (RMR) (Barbosa, 2020)

The mobile version of the platform would be aimed at the population so that with the resources of the application, they could monitor through a map, the route of the buses and locate nearby stops. This version would also have several forms with the purpose of collecting user feedback in relation to the city's transport service, such as compliments, complaints or suggestions.

The web version would be used by public managers. As the main feature of the system there would be a map with various information about the population, with the database made available for the project, and the city. It would also feature a screen displaying the answers provided by users in the mobile version for analysis. There would be the resource of sending notifications for managers to inform the population about the weather, alerts or warnings about the city.

In order to fulfill its purpose, the project was designed to be a platform, with a web and mobile version, to communicate between users and public managers responsible for transport services. Complementary to these systems is a database containing georeferenced information of "Vem Livre Acesso" users. The differential of this database is the registration of people with disabilities who have "Vem Livre Acesso", which allows associating information related to the way these users access public transport, including among other registration information about the routine use of public transport by these users.

ArcGIS Experience Builder

ArcGIS Experience Builder (AEB) is a powerful low-code tool developed by the Environmental Systems Research Institute (ESRI), a global leader in geographic information systems (GIS) software, for creating geospatial experiences. It is a software package for the elaboration and manipulation of information for the use and management of thematic databases (Martins et al., 2014). Also according to Guimarães et al. (2021), GIS is a set of technologies that have geographic intelligence and automated functions that allow consultations, transformations, complex analyses, assisting in management and decision-making based on geographic information.

Experience Builder allows people without advanced programming knowledge to create custom web applications, connecting maps and data to build graphical interfaces in a simple and intuitive way. With a drag-and-drop interface and a variety of pre-configured widgets - small windows that offer functionality - creating apps in ArcGIS Experience Builder becomes

accessible (Szukalski, 2021). In addition, it also brings the possibility for the user to write their own widget using the javascript language, for more advanced users who are interested in the developer version of the tool (Song & Rehkemper 2022).

Due to the simplicity of developing geographic representations and visualizations and associating them with data, these technologies have been widely used to develop custom web applications in various industries.

ArcGIS Survey123

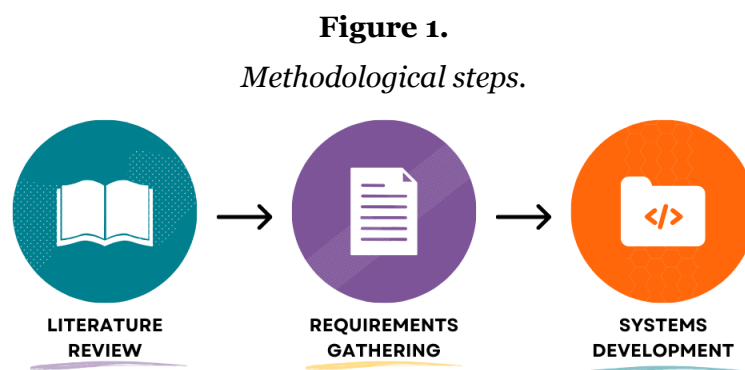
Survey123 is an integrated ArcGIS tool designed specifically for creating custom forms. Its easy and accessible interface allows you to develop web forms or surveys through a drag-and-drop interface, similar to Experience Builder. After data collection, Survey123 offers advanced visualization and analysis capabilities, allowing for the creation of reports and charts for further interpretation of the collected data. In addition, it is possible to integrate it with other ArcGIS platforms, enabling, for example, the creation of dynamic maps on the web.

Goals

Develop Sigabem web and mobile using the tools and resources offered by the ArcGIS platform.

Methodological procedures

Considering ArcGIS Online as the base platform for the development of Sigabem applications and using the tools available, the steps presented in Figure 1 and described below were adopted.



Source: The author (2023).

Literature review

In order to understand the tools provided by ArcGIS and its capabilities, a stage was carried out in which studies were conducted that involved the creation of test applications, the reading of documentation provided by ESRI, the selection of available tools, the resolution of doubts through the ArcGIS community forum and the realization of several tutorials related to the development of web and mobile applications.

Requirements gathering

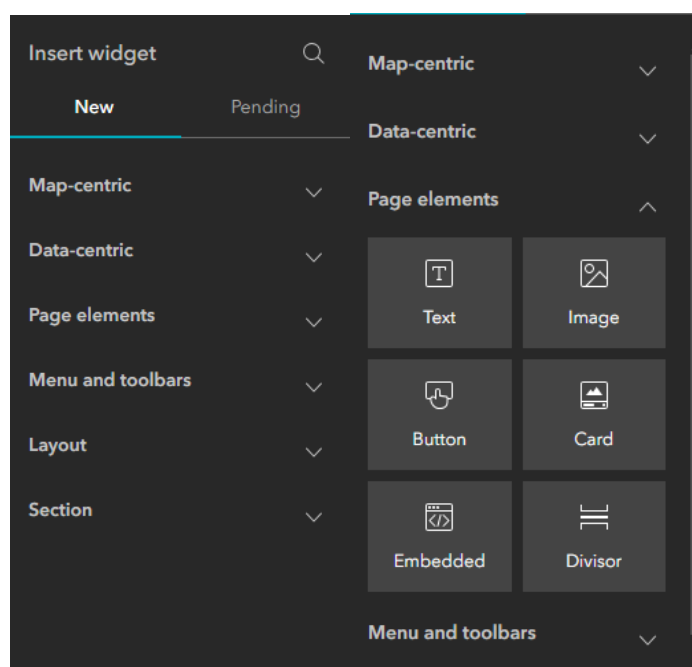
To clarify the requirements of the Sigabem platform, requirements documents detailing all the functionalities of the systems were prepared to guide developers about the needs of users, and a low-fidelity prototype was also designed to visualize the layout of the application.

Systems development

Using AEB as the main tool for developing the systems, several widgets were configured in order to meet the requirements of Sigabem. AEB provides several resources with different objectives to compose the applications, having widgets for building the layout, basic elements such as texts or buttons (Figure 2) and features related to maps, a specialty of ArcGIS itself.

Figure 2.

Viewing categorization and some ArcGIS Experience Builder widgets.



Source: The author (2023).

Development

Sigabem in ArcGIS Experience Builder

To carry out this project, the students used AEB, chosen for its easy-to-use and intuitive interface. This tool makes it possible for users to create web applications that integrate maps and data with flexible layouts, as well as drag-and-drop widgets, as previously mentioned. Being a success, it inspired the construction of other projects, such as the case of Sigabem, which could also benefit from the idea of developing a web application for data analysis and consultation, in order to promote changes in urban mobility planning.

Although it has some similarities with this and other projects, Sigabem differs significantly in its complexity and requirements. It stands out for being a more complex

application, which requires a greater amount of resources and data, in addition to requiring the active collaboration of the user.

The initial proposal of Sigabem was to provide real-time information about bus schedules to the user, using the CTM's API (Application Programming Interface) - a mechanism that allows two software components to communicate using a set of definitions. Due to bureaucratic problems, this API became unavailable during the course of the project. So, the application development team chose to explore more deeply the capabilities of AEB and ArcGIS tools in order to create new functionality and make up for the absence of this data.

Therefore, one of the developments made was the addition of a smart form in the mobile version, where responses are received in the web version. This form was developed with the Survey123 tool, also from the ArcGIS platform, which has the purpose of conducting surveys based on georeferenced data.

Made available to the user are surveys to give feedback on city bus stops or public transport service. These collected opinions can be compliments, suggestions, or even complaints. In addition, it is possible to give an opinion on the accessibility of the bus stops that the user usually uses (Figure 3).

Figure 3.

Sigabem Mobile screen with forms for collecting user feedback.

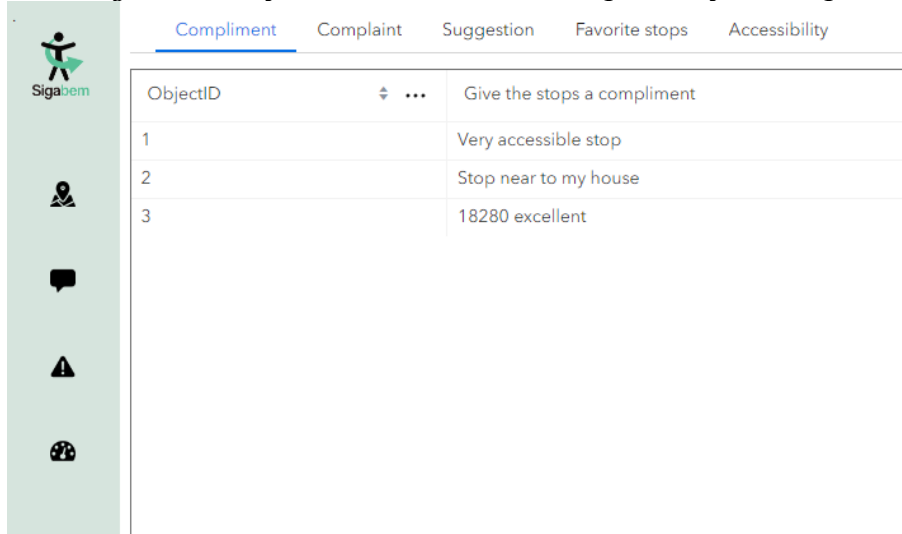
The screenshot displays a mobile application interface for collecting user feedback. At the top, there is a dark grey header with a hamburger menu icon on the left and a notification bell icon on the right. Below the header, the text 'Selected bus stop:' is followed by the address 'Luiz Freire avenue, opposite the Association of UFPE Servers.' Below this, there are four rounded rectangular buttons with blue borders and text: 'Assess the level of accessibility', 'Make a Complaint', 'Give a Compliment', and 'Make a Suggestion'. At the bottom of the main content area, there is a small text prompt: 'Use this space to evaluate the selected stop.' The bottom of the screen features a dark grey navigation bar with three white icons: a location pin, a location pin with a checkmark, and a bus icon.

Source: The author (2023).

The version of the system intended for the use of managers contains a screen that displays the feedback of the users, provided in the mobile version, as shown in figure 4. With the support of the ArcGIS ecosystem, the union of the AEB and Survey123 tools makes it possible to display the form responses directly in the application through a table.

1. Figure 4.

2. Sigabem web feedback screen with compliment form responses.

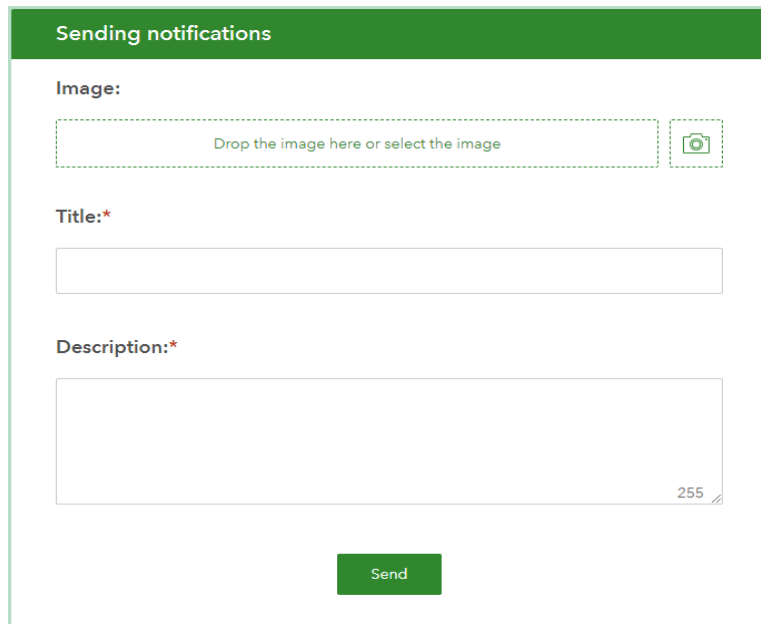


Source: The author (2023).

Still with the use of the same tool, another resource of the Sigabem project was implemented. The notification functionality consisted of managers informing the population about the weather, alerts or warnings about the RMR, as previously mentioned. To do this, the web version provides the manager with a form to be filled out with a title, description and an image to compose the notification (Figure 5). When submitting, the answers to this form are displayed in the mobile version and thus the system user receives the message. Although the tool limits UI customization, the functionality serves its purpose (Figure 6).

Figure 5.

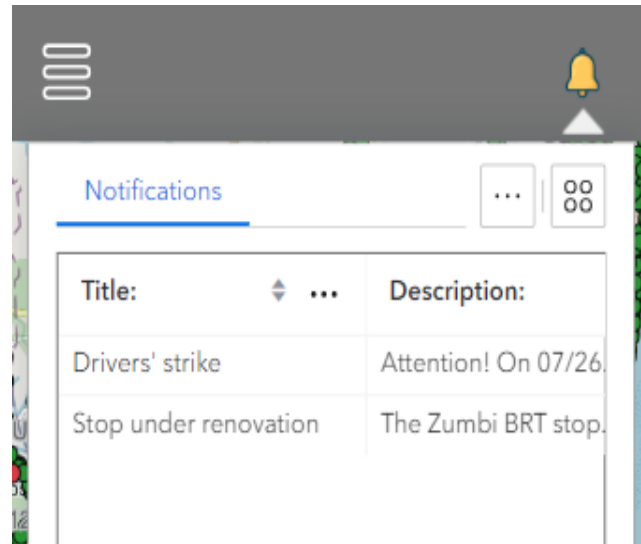
Sigabem web screen with form for sending notifications.



Source: The author (2023).

Figure 6.

Sigabem mobile screen with display of incoming notifications.



Source: The author (2023).

Conclusion

Through the use of ArcGIS tools, it was possible to implement the functionalities idealized for the project. It is notorious that the resources offered had a lot of value in the application development process, optimizing the team's time and effort. We start with a literature review to understand the features offered by the tool; we prepared a survey of the requirements of both systems with documents and a prototype until we reached the development stage itself, where widgets were used to build the applications.

We conclude that the development of the Sigabem platform with the resources made available by ArcGIS has been partially completed. For the end, it is also expected to test the implemented functionalities with possible real users of both systems, making improvements as necessary in order to improve what has been developed so far.

Funding agency

We would like to thank CNPq for its financial support through scientific initiation scholarships, as well as to the GRENDES&LabGeo laboratory located at the IFPE Research Center - Recife Campus, where this research was developed. We are also grateful for the

Productivity Scholarship in Technological Development and Innovative Extension granted by CNPq Call N° 02/2020.

REFERENCES

- Alves, F. R., & Alcalá, S. G. S. (2022). Análise da abordagem LOW-CODE como facilitador da transformação digital em indústrias | Revista e-TECH: Tecnologias para Competitividade Industrial. *Revista e-TECH: Tecnologias para Competitividade Industrial - ISSN - 1983-1838*. <https://etech.sc.senai.br/revista-cientifica/article/view/1186>
- Barbosa, I. M. B. R. (2020). Inteligência geográfica para melhorar a acessibilidade de pessoas com deficiência. Projeto de pesquisa apresentado ao Edital CNPq N ° 02/2020 - Bolsa de Produtividade em Desenvolvimento Tecnológico e Extensão Inovadora – DT. Edital CNPq N ° 02/2020.
- Frohmann, B. (1995). Taking information policy beyond information science: applying the actor network theory. In *Annual Conference of the Canadian Association for Information Science v. (n.23)*, <https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=40176306291e2cf81caecb4b6c9412853ae54031>
- Guimarães, J. C. de O., de Carvalho, V. S., da Silva, T. C. G., Ferreira, A. A., Barbosa, I. M. B. R., Bandeira, M. S., & Lima, A. S. C. (2021). Inteligência geográfica e tecnologia na contribuição ao acesso de pessoas com deficiência ao transporte público no Recife / Geographic intelligence and technology in contributing to the access of people with disabilities to public transport in Recife. *Brazilian Journal of Development*, 7(2), 17187–17198. <https://doi.org/10.34117/bjdv7n2-376>
- Horváth, B., Horváth, Á., & Wimmer, M. (2020). Towards the next generation of reactive model transformations on low-code platforms: three research lines. In *Proceedings of the 23rd ACM/IEEE International Conference on Model Driven Engineering Languages and Systems: Companion Proceedings* (pp. 1-10).
- Martins, E. M., Fortes, J. D. N., Ribeiro, G. P., & Pereira, M. F. M.. (2014). Utilização de Sistema de Informação Geográfica como ferramenta para gestão do monitoramento da qualidade do ar na Região Metropolitana do Rio de Janeiro. *Engenharia Sanitaria E Ambiental*, 19(spe), 43–50. <https://doi.org/10.1590/S1413-41522014019010001237>
- Rehkemper, G., & Song, J. (2022). Add Experience Builder Custom Widgets In ArcGIS Enterprise. Esri. <https://www.esri.com/arcgis-blog/products/arcgis-enterprise/developers/add-experience-builder-custom-widgets-in-arcgis-enterprise/>

Sahay, A., Indamutsa, A., Di Ruscio, D., & Pierantonio, A. (2020). Supporting the understanding and comparison of low-code development platforms. In 2020 46th Euromicro Conference on Software Engineering and Advanced Applications (SEAA) (pp. 171-178). Portoroz, Slovenia: IEEE. doi: 10.1109/SEAA51224.2020.00036.

Szukalski, B. (2021). ArcGIS Experience Builder overview and concepts. Esri.
<https://www.esri.com/arcgis-blog/products/experience-builder/mapping/experience-builder-overview/>