

DESIGN OF AUGMENTED REALITY MOBILE APP FOR ANDROID PLATFORM APPLIED TO SECURITY AND SURVEILLANCE

DESIGN OF AUGMENTED REALITY MOBILE APP FOR ANDROID PLATFORM APPLIED TO SECURITY AND SURVEILLANCE

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Summary - For the design of this prototype we suggest the use of technologies such as: *Spring Boot 3.2* for data management using the *MVC* model (model, view, controller); *Apache Tomcat 10*, for the publication of the *REST API* service; *MariaDB* as database; *Unreal Engine 5* for the interface of the mobile App. Similarly, the software tools, *Dia* and *Evolus Pencil*, which are programs for drawing structured diagrams (Dia, 2024), and the design of use cases, respectively (Evolus, 2024) were used.

The augmented reality App provides a safe and reliable way to conduct patrols through virtual QR codes and using emerging technologies such as augmented reality and Android smartphones. In addition, it facilitates the planning of the supervision and surveillance program, the management of client portfolios, the control of security guards, the management of areas and spaces for supervision, as well as the recording of observations at the time of a patrol.

The aforementioned allows savings in the acquisition of printing equipment, paper or other devices or Tags existing in the market for round robin activities.

Keywords: Rondin, Android mobile app, Augmented Reality, Spring Boot, Unreal Engine 5.

Abstract -- The augmented reality mobile app for security and surveillance is a prototype to be implemented for the company Combustibles y Derivados BELAR S.A. de C.V. (CODEBSA) and its objective is to perform patrols using an Android cell phone, through a virtual QR code, as well as the registration of observations at the time of such activity.

For the design of this prototype we suggest the use of technologies such as: *Spring boot 3.2* for data management using the *MVC* model (model, view, controller); *Apache Tomcat 10*, for the publication of the *REST API* service; *MariaDB* as database; *Unreal Engine*

5 for the interface of the mobile App. Similarly, software tools, *Dia* and *Evolus Pencil*, which are programs for drawing structured diagrams (Dia, 2024), and the design of use cases respectively (Evolus, 2024), were used.

With the augmented reality App, it provides a safe and reliable way to conduct tours through virtual QR codes and using emerging technologies such as augmented reality and Android smartphones. It also, facilitates the planning of the supervision and surveillance program, the management of client portfolios, the control of security guards, the management of areas and spaces of supervision as well as the registration of observations at the time of a patrol.

The aforementioned allows savings in the acquisition of printing equipment, paper or other devices or Tags existing in the market for patrol activities.

Keywords - Rondin, Android mobile app, Augmented Reality, Spring Boot, Unreal Engine 5.

INTRODUCTION

"The word security has its origin from the Latin **securitas** (Quality of being without worry, without having to be careful)." (DECEL, 2024).

Currently, security and surveillance services are used in everyday life and can be observed in schools, businesses, public spaces, airports, among others, that require protection or supervision of something valuable.

Just as security became an everyday thing, the same is happening with augmented reality (AR) applications. As defined by *Epic Games*, "Although augmented reality (AR) may seem like a futuristic concept to us, in reality, it is one of the most accessible new technologies out there. Most of us, carry devices and applications in our pockets that allow us to use augmented reality, from filters on social networks to mobile video games, which

makes its potential almost limitless." (Epic Games, 2024)

But what is augmented reality? "Augmented reality is an interactive experience that enhances the real world with computer-generated perceptual information." (SAP, 2024).

Combustible y Derivados BELAR S.A. DE C.V. (CODEBSA) is a 100% Mexican company located in Monclova, Coahuila, Mexico, whose main activity is the marketing and distribution of petroleum products such as diesel and gasoline (Mexico, 2024). This company has a security and surveillance area created to safeguard the company's assets and property.

Problem

One of the problems encountered with regard to security and surveillance is the design of the supervision and surveillance program and the conduct of patrols. This is due to the fact that the security chief in charge of designing the program designs it in a pre-printed format, recording with a ballpoint pen the rounds to be made and those carried out. This means that the supervision program, since it is on paper, can be damaged, lost or show inconsistencies in the patrols carried out.

With regard to the action of conducting a patrol, when it is recorded in the supervision program, the security guard in charge does not conduct it, does it halfway or may record the conduct of the patrol when it has not been conducted.

For this reason, it was proposed to CODEBSA to implement an application that allows planning and designing supervision and surveillance programs using a web application and through an augmented reality Android mobile App, to carry out patrols in a safe and reliable way.

Target

The development of these applications is aimed at: creating and managing supervision and surveillance programs, making rounds by means of virtual QR codes, managing catalogs of clients, security guards, spaces and areas of supervision, printing the supervision program, as well as controlling access to the applications by means of username and password.

For this reason, the implementation of these applications will provide technological and competitive innovation to CODEBSA, as well as the assurance of the realization of rounds, generating greater confidence in future customers who require the security service.

For the design of the prototype of the web application and mobile App, we propose its implementation in the following technologies:

Web application

- **Spring Boot 3.2 Framework.** Framework that allows the creation of standalone applications with very little configuration (Spring Boot, 2024).
- **Java 17**, as a programming language that together with the *Spring Boot 3.2 Framework*, is proposed for the design of the web application and *REST API* services.
"Java is a widely employed object-oriented programming language and software platform that runs on billions of devices, including laptops, mobile devices, game consoles, medical devices, among others. The rules and syntax are based on C and C++." (IBM, 2024).
- **MariaDB**, as a database for data storage and exploitation.
It is one of the most popular relational databases, providing performance, stability and openness, it is compatible with *Oracle Database* (MariaDB, 2024).
- **Materialize CSS**: CSS framework to apply styling to the web application.
"Created and designed by Google, Material Design is a design language that combines classic principles of successful design along with innovation and technology. Google's goal is to develop a design system that enables a unified user experience across all of its products on any platform." (Materialize CSS, 2024).
- **Android Platform**: "Android is the free platform for the development of mobile applications created by Google. It has currently become the leading platform compared to others such as iPhone or Windows Phone." (Tomás Girones & Lloret Mauri, 2022).

Mobile application

- **Unreal Engine 5**: Graphics engine for augmented reality design.
It is defined as "the world's most accessible and advanced real-time authoring tool at your disposal to make it happen." (Epic Games, 2024). Unreal Engine's official website mentions about visualizing designs and creating cinematic experiences, as well as high-quality games for computers, consoles, mobile devices, including virtual reality (VR) and augmented reality (AR) (Epic Games, 2024).

The aforementioned technologies allow the development and implementation of the augmented reality App. Therefore, it is necessary to perform several processes such as requirements gathering, modeling, screen proposal, preparation of the development environment, development of the application prototype, as well as the acceptance, approval and implementation stage of the project.

DEVELOPMENT

For the development of the augmented reality App and web application, several stages were taken into account, which are mentioned below, as well as the use of modeling tools to represent the analysis obtained and proceed to the design of prototypes.

➤ Stage 1: Elicitation of requirements:

At this stage, the security coordinator is interviewed, who explains the current process of patrols and the design of the supervision and surveillance program, the users who participate in the processes, as well as the current problems in the security area.

As a result, the following requirements have been identified:

- Difficulty in preparing the supervision and monitoring program when more than one supervision area is to be monitored, since this control is currently carried out in a printed format.
- The rounds are not carried out in a timely manner, or at times are not carried out at all.
- The capture of observations at the time of a patrol is limited to the space of a printed sheet of paper.
- There is no centralized catalog of security guard personnel.
- There is no centralized customer catalog.
- The spaces and areas of supervision do not have homologated names.
- Access to the information on rounds is exposed to physical sheets of paper or photographs, as the case may be.

➤ Stage 2: Requirements modeling.

The requirements modeling has been designed using use case diagrams.

A use case diagram is a graphical representation that shows how users interact with a system, showing possible actions and responses (Carter, 2024).

Below are some of the use cases that are implemented in the web and mobile application.

Use case 1: Log in and log out.

This use case shows the components for the login and logout requirement.

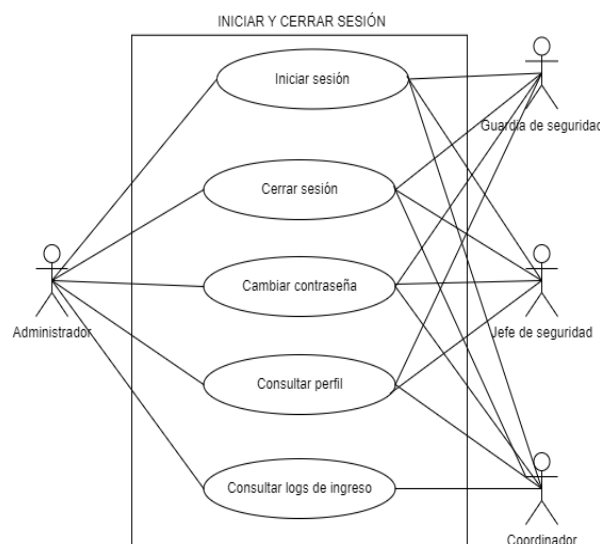


Figura 1. Use case: login and logout.

Use case 2: Manage the monitoring program.

This use case shows the components for the monitoring and surveillance program.

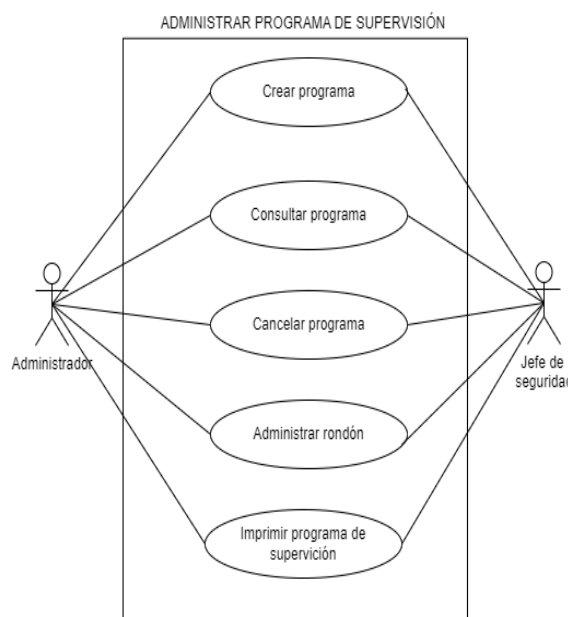


Figura 2. Use case: manage monitoring programs.

Use case 3: Manage rounds.

Use case that represents the components that are contemplated in the administration of the rounds.

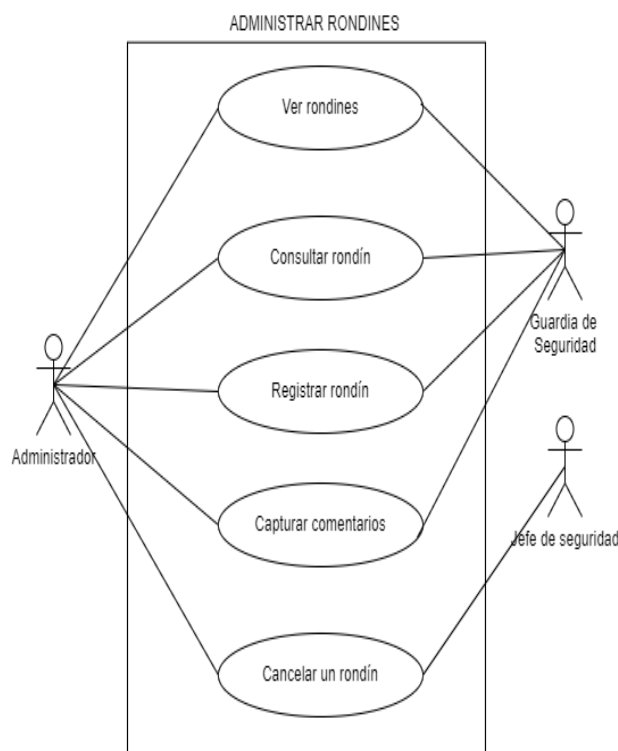


Figura 3. Use case: manage rounds.

Use case 4: Manage user.

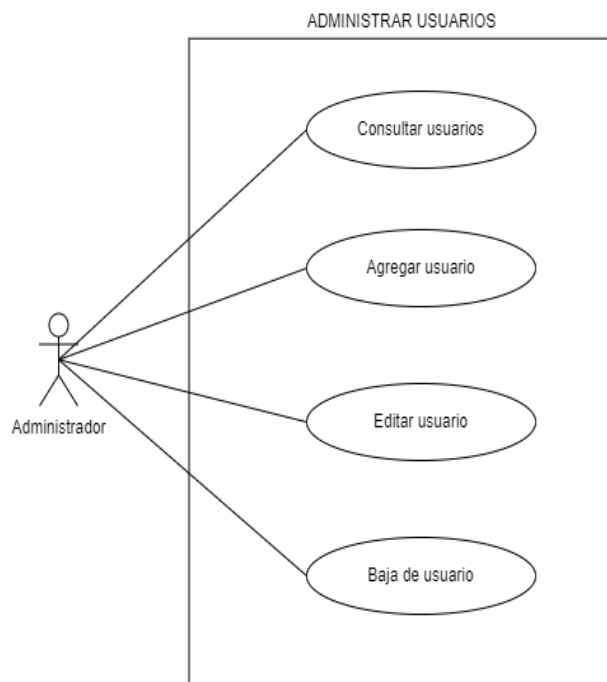


Figura 4. Use case: manage users.

At this stage, the modules to be developed have been identified, as well as the different user roles in the application.

The following is a description of the main modules as a result of the requirements elicitation:

Tabla 1. Identified modules.

No.	Module
1	Supervision and surveillance programs.
2	Rondines.
3	Security guards.
4	Customer catalog.
5	User catalog.
6	Catalog of spaces and areas of supervision.

The following roles or actors were also identified.

Tabla 2. Roles in the application.

No.	Role
1	Head of security.
2	Security guard.
3	Security Supervisor.
4	Administrator.

➤ Stage 4: Application interface design.

The *Evolus Pencil* software was used in the interface design of the application. *Pencil* is a prototyping tool that allows the creation of *mockups* (Evolus, 2024).

The prototypes designed for the following interfaces are shown below.

- Login interface.
- Main screen interface of the web application.
- Interface of the monitoring programs.
- Security guard catalog interface.
- User catalog interface.

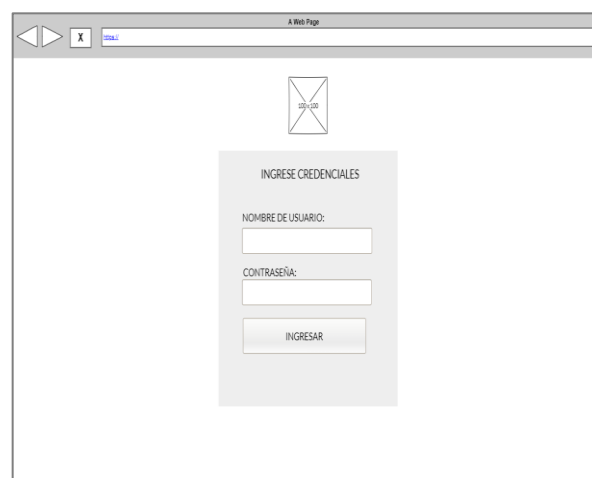


Figura 5. Login interface.

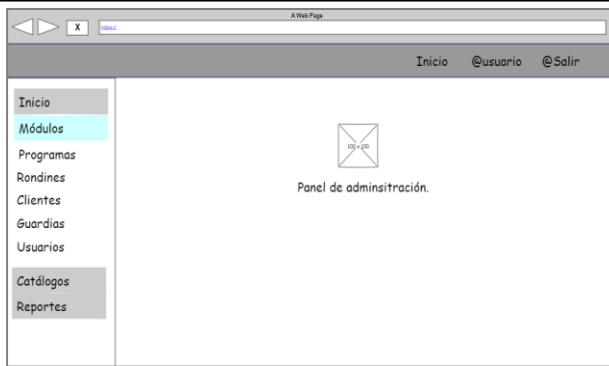


Figura 6. System main screen interface.

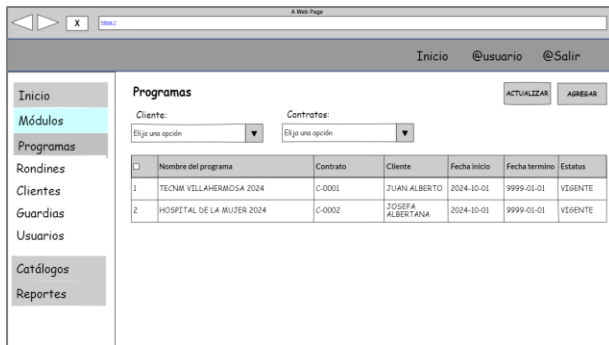


Figura 7. Supervision program interface.

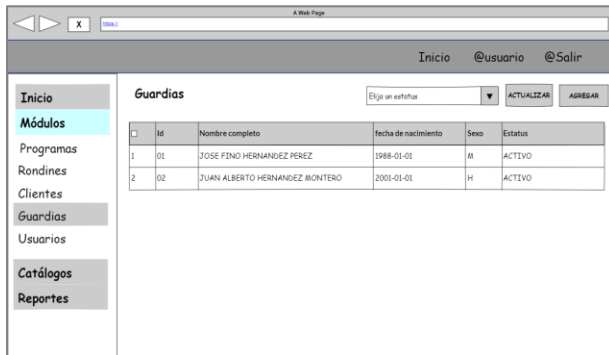


Figura 8. Guard catalog interface.

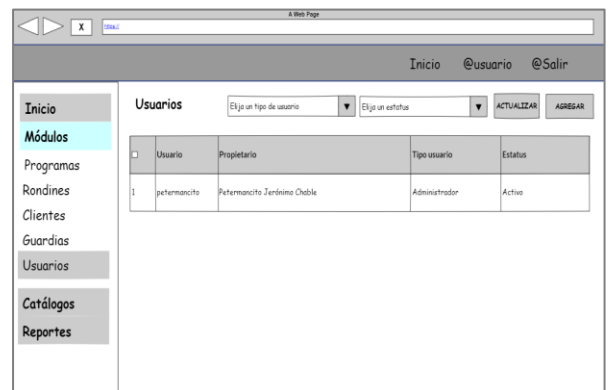


Figura 9. User catalog interface.

The interface for the mobile application is shown below.



Figura 10. Mobile login interface.



Figura 11. Mobile interface main menu.



Figura 12. Rondines mobile interface.

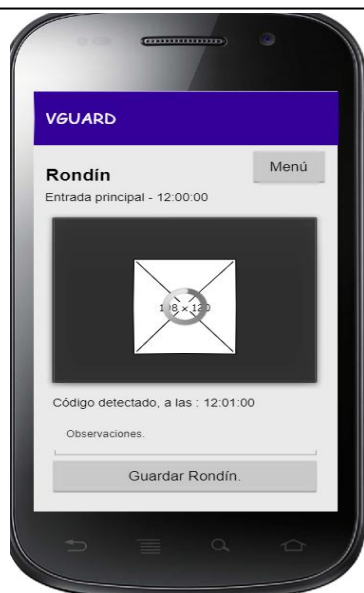


Figura 13. Mobile interface.

➤ **Stage 5: User interface.**



Figura 14. Login screen.

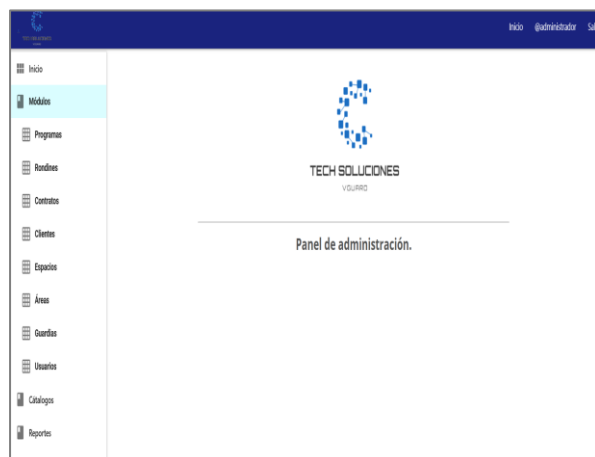


Figura 15. Main screen of the web application.

DISCUSSION AND ANALYSIS OF RESULTS

Discussion

By conducting a market research, other applications similar to the one presented in this research were found. Among which we can mention:

- **OnPatrol**: Patrol control platform, with mobile version for guards and printed QR validation (redgps, 2024).

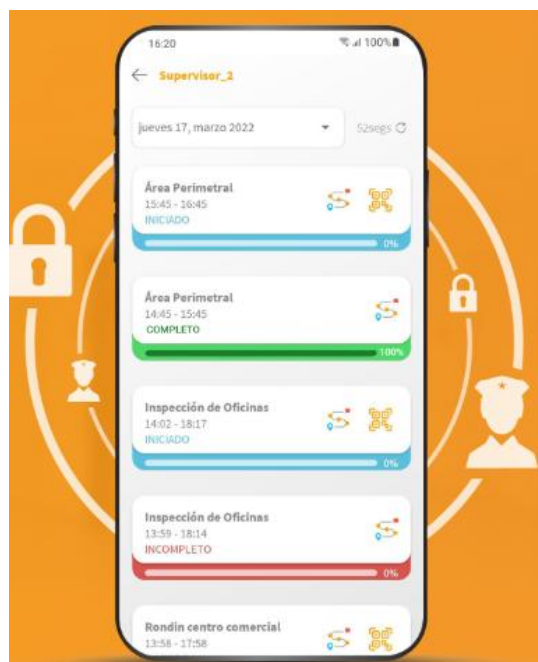


Figura 16. OnPatrol application.

- **Round K: Route** control system, designed by the company Eskayser, focused on the security of condominium owners through geolocation and also requires a computer for the installation of the round scheduling software (Eskayser, 2024)

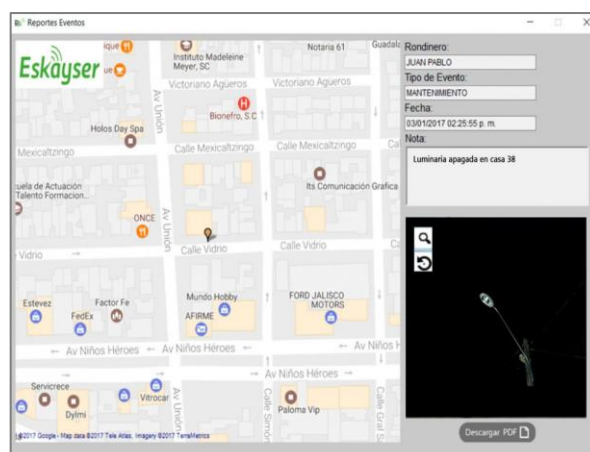


Figura 17. Application Round K.

- **MOBITRAXX:** Application designed for the control of rounds, which allows the registration of incidents, panic button, inactivity time, among others, using RFID TAGS (Mobitraxx.net, 2025) .



Figura 18. Mobitraxx application.

As described above, the platforms or systems share certain features such as: the scheduling and execution of patrols, the recording of anomalies, as well as the use of a mobile App for Android to record incidents.

However, these applications do not implement the use of augmented reality, in their case they rely on printed QR codes, RFID TAGS or GPS location points to perform the tour. In the case of printed QR codes, they have the disadvantage of degradation over time and have to be printed periodically. Something similar happens with the RFID TAGS that, being exposed to the environment, can be damaged with use or lost; in addition, if it is required to be implemented in a new supervision area, we are forced to acquire more units and new card readers.

From the analysis of this comparison, we can point out that these technologies may generate additional costs after their implementation.

Analysis of results

The results of the tests performed on the Android augmented reality App prototype and the web application are as follows:

- Ease in the design of monitoring and surveillance programs, compared to those recorded on paper.

- There is no need to print the QR codes, since they are generated digitally through the App, saving resources and time.
- It provides certainty in the realization of patrols, since the security guard must go to the place to visualize the QR code. This provides evidence of the activities carried out.
- Observations are recorded at the time of a patrol and are not captured on paper files.
- Improved administration of the catalog of clients managed by the security coordinator.
- Easy handling of the basic security guard template.
- Time savings when printing or generating the "supervision and surveillance program" report.
- Access to data and information is secured by providing a username and password.

As mentioned in the previous points, the use of an app with augmented reality for patrols generates savings in equipment and/or device acquisition costs that deteriorate with time, weather or space. In this way, the realization of patrols will require virtual QR codes, which are only generated and read by means of the App.

By implementing this application in the field of security and surveillance, it allows the company Combustibles y Derivados BELAR S.A. de C.V., to be at the forefront of technology with the use of augmented reality in their services; this would generate the attraction of new customers by ensuring that the service is provided safely, on time and with evidence that proves the work done.

Regarding other applications for security and surveillance, we can mention: *OnPatrol* (redgps, 2024) , and the App *ESKAYSER RONDA K.* (Eskayser, 2024) , both are intended to perform patrols, but do not include augmented reality technology, and that is why the proposed application is distinguished from other applications that may be on the market.

By not implementing this application, CODEBSA will continue with ineffective planning of the patrol programs, the patrols will continue to be recorded in printed files, as well as the lack of security of the patrols carried out and the lack of going to the site to carry out the patrol.

CONCLUSIONS

Therefore, we can conclude that the prototype presented in this article, is a cutting-edge technology, which will allow cost savings by not relying on other devices or additional physical resources, such as: readers, printed QR codes, use of Bluetooth, among others; similarly, it will allow savings in printing times of QR codes, without having to go to the site to place them and / or maintain them. With this we respond to the needs of the company, since the application allows from the administration of

security guards, clients, patrols to the design of supervision programs.

In order to increase the reach to other platforms, it is considered as the next stage the development of the mobile App in the platforms: IOS, Windows among others. In the future, the augmented reality App will be able to implement other features such as access control for authorized personnel to the different existing areas.

Other features planned to be included are the recognition of potential risks, alerting users, for example, about exposed wires or hazardous materials. With this functionality, the application can even be applied to other environments such as automotive or industrial.

BIBLIOGRAPHY .

- [1] Carter, M. (September 24, 2024). Complete guide to use case diagramming. Retrieved from <https://boardmix.com/es/articles/case-use-diagram/>
- [2] DECEL. (10/25/2024). Diccionario Etimológico Castellano en Línea. Retrieved from <https://etimologias.dechile.net/?seguridad>
- [3] Day (11/15/2024). Overview. Retrieved from <http://dia-installer.de/index.html.es>
- [4] Epic Games (November 19, 2024). Features. Retrieved from <https://www.unrealengine.com/es-ES/features>
- [5] Epic Games (02 of 11 of 2024). Augmented reality. Retrieved from <https://www.unrealengine.com/es-ES/explainers/augmented-reality>
- [6] Epic Games (November 20, 2024). UNREAL ENGINE. Retrieved from <https://www.unrealengine.com/es-ES>
- [7] Eskayser (November 18, 2024). Round K. Retrieved from <https://eskayser.com/rondines-aplicacion/>
- [8] Evolus (11/15/2024). Pencil project. Retrieved from <https://pencil.evolus.vn>
- [9] IBM (11/18/2024) What is JAVA? Retrieved from <https://www.ibm.com/mx-es/topics/java>
- [10] MariaDB (November 19, 2024). MariaDB Server: the innovative open source database. Retrieved from <https://mariadb.org/>
- [11] Materialize CSS (November 19, 2024). Materialize CSS. Retrieved from <https://materializecss.com/about.html>
- [12] Mexicoo. (11/17/2024). Combustibles Y Derivados Belar, S.A. de C.V. Retrieved from <https://mexicoo.mx/combustibles-y-derivados-belar-s-a-de-c-v-9276422>
- [13] Mobitraxx.net (March 03, 2025). Real-time activity monitoring. Retrieved from <https://www.mobitraxx.net/es>
- [14] redgps. (November 19, 2024). OnPatrol. Retrieved from

<https://www.redgps.com/soluciones/rondines-de-seguridad>

- [15] SAP. (10 of 11, 2024) What is augmented reality (AR)? Retrieved from <https://www.sap.com/latinamerica/products/scm/industry-4-0/what-is-augmented-reality.html>
- [16] Spring Boot (November 19, 2024). Spring Boot. Retrieved from <https://docs.spring.io/spring-boot/index.html>
- [17] Tomás Girones, J., & Lloret Mauri, J. (2022). Introduction to Android. Spain: Marcombo.

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