- ORIGINAL ARTICLE -

Implementation of the Single Equine Document (DUE) in the Province of Buenos Aires, Argentina

Implementación del Documento Único Equino (DUE) en la Provincia de Buenos Aires, Argentina

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Abstract

In October 2018 in Argentina, the Ministry of Agroindustry of the Province of Buenos Aires (MAIBA) implemented the *Single Equine Document* (DUE) as a new individual identification system for all equines located in the Province of Buenos Aires. With this new identification system, the old markings and signals system is replaced by the implantation of a single-code microchip in the equine's neck and an identification document for the horse and its owners. The implementation of this system involved generating several official registries, for which MAIBA needed to develop and implement an IT Management System for the DUE. This Argentine development generates a contribution in equine control by government organizations and facilitates information to veterinarians through mobile devices. This article discusses the most important details of the development carried out and shows the scope it has had so far. It presents statistics of the use of the application by different regions of the Province of Buenos Aires.

Keywords: equine identification, mobile app development, public sector management, microchipping, offline first.

Resumen

En octubre de 2018 en Argentina, el Ministerio de Agroindustria de la Provincia de Buenos Aires (MAIBA) implementó el *Documento Único Equino* (DUE) como nuevo sistema de identificación individual para todos los equinos radicados en la Provincia de Buenos Aires. Con este nuevo sistema de identificación se sustituye el antiguo sistema de marcas y señales por la implantación de un microchip de código único en el cuello del equino y un documento de identificación para el caballo y sus propietarios. La implantación de este sistema supuso la generación de varios registros oficiales, para lo que el MAIBA necesitó desarrollar e implantar un sistema de gestión informática para el DUE. Este desarrollo argentino genera un aporte en el campo del control equino por parte de los organismos gubernamentales y además facilita la información a los veterinarios a través de dispositivos móviles. En este artículo se comentan los detalles más importantes del desarrollo realizado y se muestra el alcance que ha tenido hasta el momento. Se presentan estadísticas de uso de la aplicación por diferentes regiones de la Provincia de Buenos Aires.

Palabras claves: identificación equina, desarrollo de aplicaciones móviles, gestión del sector público, microchip, offline first.

1 Introduction

Years ago, the Argentine Province of Buenos Aires lacked information on the equine population to simplify the planning of related public policies and decision-making. For these reasons, from the enactment of Law 13,627 and its regulation through Decree 1,734, a new Equine Identification Record is created, called *Single Equine Document*, also known by

https://kundenschatz.de/blog-post/branding-was-ist-branding/

Figure 1: *Traditional "brand by fire" that was used on horses to identify them.*

its acronym in Spanish of DUE (Documento Único Equino), with the goal of replacing, in the province of Buenos Aires, the old "brand by fire" (Fig. 1) established by Decree Law 10,081/83 – Rural Code – for identification, and Law 10,891 – Single Bill of Transportation – to regulate the transfer of equine species [1]. The DUE is a practically painless method that allows identifying horses by implanting in their neck a microchip that is similar in size to a grain of rice, and which will prove ownership and protect animals during transportation.

With Resolution No. 248/18 MAGP [2], registration in the system becomes mandatory for all equines in the Province, be they pure- or half-breed, whether or not they are marked by fire, and without distinction of activity, sex, or age. Therefore, every person who owns equines must, without exception, request the registration of their animals with a veterinarian that is registered in the system. The professional will collect the characteristics of the horse (coat, age, sex, etc.), will take some photographs, and will implant the electronic device. Once the legal deadlines for identification of all unregistered equines have expired, new foals that are to be registered must be accompanied by their mother, which in turn must have been previously registered to the name of the person requesting the registration of the foal.

As a result, the Ministry of Agroindustry of the Province of Buenos Aires (MAIBA) needs to develop a system that not only supports the Equine Identification Record, but also the generation of registries related to the implementation of the document, such as Registered Veterinary, for creating new DUEs (both private and official), and Animal Identification Device Suppliers. Having a central registry allows the enforcement authority (in this case the Ministry of Agroindustry) to have the animal species under state supervision, and is thus able to:

- build the genealogical tree of the animal (parents, grandparents, etc.)
- track animals from birth to death
- reduce horse theft and clandestine slaughter
- carry out sanitary controls to avoid zoonotic diseases
- monitor the vaccinations received by the animal

Ultimately, this identification allows regularizing the animal population by municipalities and knowing, among other things, where these animals come from, where they go, what they are used for, and whether they are sports horses or workhorses.

The purpose of this article is describing the development carried out and showing the scope it has had so far. It is organized as follows: Section 2 describes the general framework of the work carried out; Section 3 covers aspects pertaining to the electronic identification of equines; Section 4 describes the system developed; Section 5 describes information about documents that have been registered in the system, so far along with some numbers to show the scope that this effort has had; and finally, in Section 6, our conclusions are detailed, and future work is described.

2 Context and legal framework

Over time, different methods were used for artificial animal identification depending on the species: heat branding to mark the cattle's skin, cold shoeing using liquid nitrogen, tattoos, use of earrings with visual codes, and so forth. Many of these procedures are painful for the animal and, on many occasions, infections or infestation by pathogens and parasites occur. Some methods, such as with the use of earrings, necklaces or rings, do not guarantee a permanent identification of the animal, since the tags can be easily lost or intentionally removed in certain circumstances [3].

In recent years, electronic identification in Argentina has grown steadily, mainly in relation to livestock activities. These types of activities require that livestock be registered in a reliable way for decision-making. In this sense, electronic IDs are not only a much more reliable identification method than traditional ones, but they are also less damaging to the animal.

Law 13,627, sanctioned by the Senate and the Chamber of Deputies of the Province of Buenos Aires, is thus aimed at promoting the use of electronic IDs for equines, and ensures that:

- owners have a method that is easy to apply, indelible, inviolable, reliable, harmless, durable and standardized
- authorities have a property registry that enables an effective control for the purpose of traceability, using new technological elements that are available.

Compliance with equine livestock identification will allow offering a reliable individual and herd traceability system, sufficient to ensure both the origin and ownership of the animals. It will also enable the development of efficient inspection processes, without the need for bureaucratic procedures or delays in transportation. It will contribute to the ordering of equine records, aimed at determining the amount of animals of this species that exist in the Province of Buenos Aires. Clearly identifying the equine and its owner is an extremely crucial action in the fight against cattle theft and the determination of civil liability in cases of accidents.

Figure 2: *Microchip and applicator used.*

3 Electronic identification of equines

The individual identification of equines consists of a subcutaneous electronic device (Fig. 2) and an identification document of the animal and its owner (Fig. 3), uniquely linked to a record in a computerized database [4].

When it comes to electronically identifying animals, the quality component is very important and decisive. This activity requires a level of security that can only be guaranteed by using technologies that meet internationally recognized standards. For this reason, the microchip that is implanted in the equine with the applicator shown in Fig. 2, is a passive identifier with FDX-B (Full Duplex) technology in accordance with the definition of ISO 11,784 [5] and 11,785 [6] standards. On the other hand, the microchips are provided by companies registered in MAIBA, and they can be acquired by the owner of the equine or by the authorized veterinarian who intervenes in the identification.

To read the microchip, a radio frequency reader must be used that complies with the ISO 11.785 standard (Fig. 4), i.e., it must be at least capable of reading identifiers and displaying the country code and national identification code stored in it. In addition, the reader must have a technology that allows wireless connection to a cell phone or digital tablet to transfer the microchip number read. The reading of the identification number of the microchip and its link with the DUE can only be done through the use of a radio frequency reader that meets the aforementioned requirements. For this reason, it is not allowed to register the number of an equine microchip manually.

The identification procedure must be carried out by an authorized official or private veterinarian, which implies being duly trained [7] and previously registered in the MAIBA database [8]. The veterinarian will be responsible for opening the DUE, at the request of the owner of the equine.

Once the acting veterinarian has finished opening the document, the enforcement authority will issue the document. The mere implantation of the microchip does not mean that the animal is officially identified. The document is printed in color and is delivered to the owner by the professional who performed the opening. This document will be unique for the entire life of the animal and must accompany it on all its movements. It contains, as shown in Fig. 3, the details of the owner of the equine, the acting veterinarian, a review, photos of the animal and the microchip code. The personal data, the microchip number and the qr code were removed for obvious reasons.

In the following section, the DUE management system is described.

4 Description of the system developed

In the two following subsections, the system operation and architecture will be detailed, respectively.

4.1 General operation

Prior to the development of the DUE, MAIBA implemented its Management Web Platform, made up of multiple administrative systems of interest to the agency (Fig. 5). The DUE management system has been developed and integrated into this platform, mainly aimed at centralizing official records administration.

The systems within this platform share several services in common, such as user identification through the unique tax code granted by the Federal Tax Administration (AFIP), the automatic generation of electronic documents through communication with the Electronic Document Management of Buenos Aires (GDEBA) system, and the remote payment system.

Unlike the rest of the systems in the platform, the DUE module incorporates a mobile application as an extension (Fig. 6). This application is conceived as a work tool to be used by the qualified veterinarian to record the equine's data and then generate the corresponding document. Data registration cannot be done from the web application, this is why this mobile application needs to be installed and used.

Given that most of the places where the veterinarian performs equine microchip implantations are rural areas, they generally do not have an Internet connection and it is therefore essential that the application allows them to record the data offline[1]. This means that the application must allow the information to be stored in the local memory of the mobile device used until it has a connection to synchronize it.

In order to access the mobile application, the person must have a username and password. Since credential validation is carried out through a web service of the web platform, connection to the Internet is required, without exception, when logging in. Once the session is started, it remains active until the user decides to end it manually, allowing them to use the application without an Internet connection. Everything that involves user management is done through the web application.

[1] `http://offlinefirst.org/`

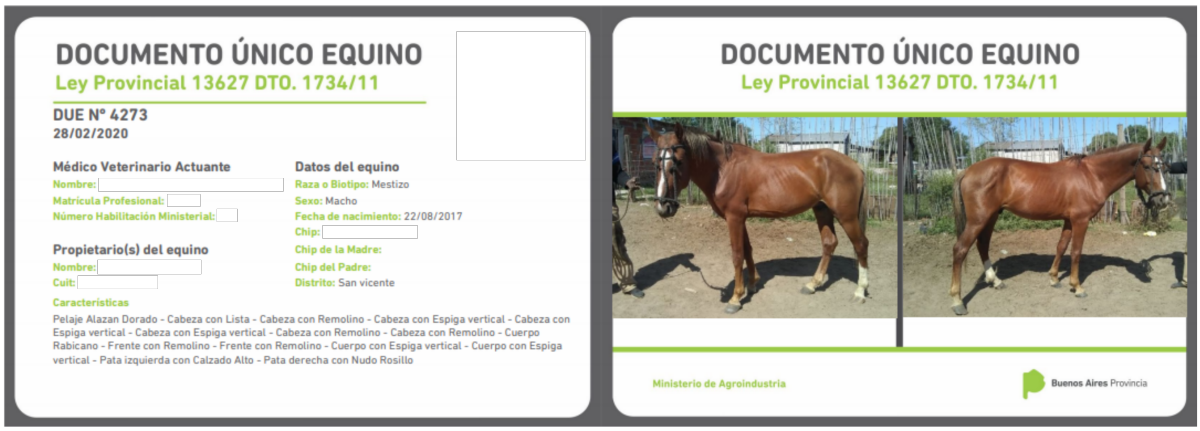

Figure 3: *Example of DUE delivered to the owner.*

Figure 4: *Radio frequency readers used.*

Figure 5: *MAIBA Management Web Platform.*

Figure 6: *Mobile app home screen.*

Once the user has been authenticated in the mobile application, if they are a qualified veterinarian, they will be able to see the requests that are pending registration and that have been assigned to them. Requests are generated by the veterinarian assigned to the owner of the equine, and they can only be generated using the web application. For each request, the corresponding owner(s), the status, and the number of equines to be identified are shown.

The mobile application will synchronize the local content with the server when it has an Internet connection. Upon synchronization, new requests to be fulfilled are added and pending requests are updated with the information collected.

On the other hand, the mobile application allows DUE management, i.e., new equine documents can be generated, their information edited, they can be deleted, their details can be displayed, and they can be synchronized with the web application as mentioned above. Each DUE corresponds to a specific request; therefore, in order to manage it, the corresponding request must be first identified (Fig. 7). The maximum number of equines that can be identified in a single request is specified at the time of creation.

To register the equine, the user completes a form with basic data and details on the "particulars" that allow visually differentiating the animal from similar ones, such as scars, moles, depressed areas, swirls, marks, tattoos, spikes, and so forth. For this, the application will display on the screen a profile diagram of the equine selected by the user, in SVG format, on which the veterinarian will be able to indicate the different particular characteristics observed (Fig. 8 and Fig. 9). Each type of feature will have its own icon to distinguish it from the others.

The veterinarian must also enter photos of the left side and the right side of the equine, which will be

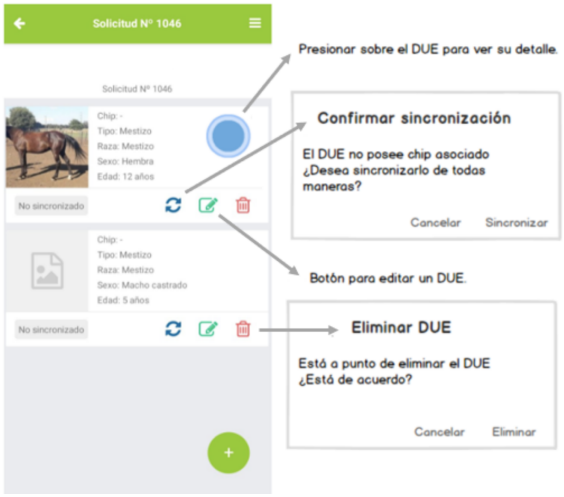

Figure 7: *DUE management screen.*

printed to the document. Both photos can be taken on the spot using the device's camera, or they can be selected from its memory.

On the other hand, the veterinarian must indicate the number of the microchip implanted in the equine, which will ultimately match its DUE number. The only way to obtain this number will be through the use of a radio frequency reader, linked in advance with the device via Bluetooth.

Once the reader has been linked to the application, the user can use it to read the microchip number and associate it with the corresponding DUE; there is no option to do this manually (Fig. 10). When reading a microchip, the application verifies if it is valid, i.e., if the company that manufactured it is registered with MAIBA and if the number is within a batch authorized by the agency. The application will not allow an invalid or previously implanted microchip to be linked to the equine's DUE.

It should be noted that the DUE generated will be stored in the device's local memory until the user synchronizes it, manually, with the data stored on the server. This is why editing and deleting a DUE will only temporarily affect the memory of the device until it is later synchronized. Once the DUE is synchronized, it cannot be edited in the application, and it can only be removed locally. The application will allow the user to save DUEs as a "draft" version at any time, allowing edits to the information later on, as long as it has not been synchronized with the server.

4.2 Architecture

End-users operate within the system through a mobile application (available for Android 4.1 or higher) and a web application. Figure 11 shows a general model of service-oriented architecture.

The mobile application, for which qualified veterinarians make use, was developed using the framework React Native [9] and the libraries MobX [10] and MobX State Tree [11]. React Native allows developers to build native mobile applications for both, Android and iOS. For that reason, the mobile application can be categorized as a multi-platform interpreted app [12].

The web managing application, used by the administrative staff of the MAIBA, was developed using web technologies (HTML5, CSS3, and Javascript). Both mobile and web applications communicate through the HTTP protocol using an API developed with PHP v7.1 [13] and the framework Symfony v2.8 [14]. Finally, the data is managed using a MariaDB database v10 [15].

5 Statistics of use of the system

To June 2021, 6,147 documents have been registered in the system, generated since the end of 2017 (see Fig. 12). Out of the 106 districts of the Province of Buenos Aires that have generated documents, Ayacucho and La Plata make up 30 percent of total (see Fig. 13). The Figure 14 describes the sex and age of the registered equines. The subfigure on the left shows the percentage of female, male and castrated male equines. It on the right shows the box plot corresponding to the ages of the equines, the age atypicals, the mean and deviation.

It is worth mentioning that the registrations carried out between December 2017 and October 2018, before the implementation of the Law, were conducted jointly with veterinarians and equines belonging to MAIBA, as a real test of the application in a controlled environment.

As of November 2018, and with the progress of the communication plan and the training provided by MAIBA to different veterinarians in several districts of the Province of Buenos Aires, an increase in the number of DUEs performed began to be recorded, reaching its peak in August 2019.

However, once the maximum number of records is reached, a decline is observed, due to reasons external to the system: on the one hand, the national elections that resulted in a change of management in the Province in the second half of 2019 and, on the other, the COVID-19 pandemic that affected the entire globe.

6 Conclusions and Future Work

The article presents a software development to identify, monitor, and control equines according to the new Argentine legislation. The work carried out is relevant for the agroindustry sector.

It should be noted that the development of the system helped discontinue the use of branding by fire in the Province of Buenos Aires, while it ensured that each animal has its own document and a microchip to be electronically identified.

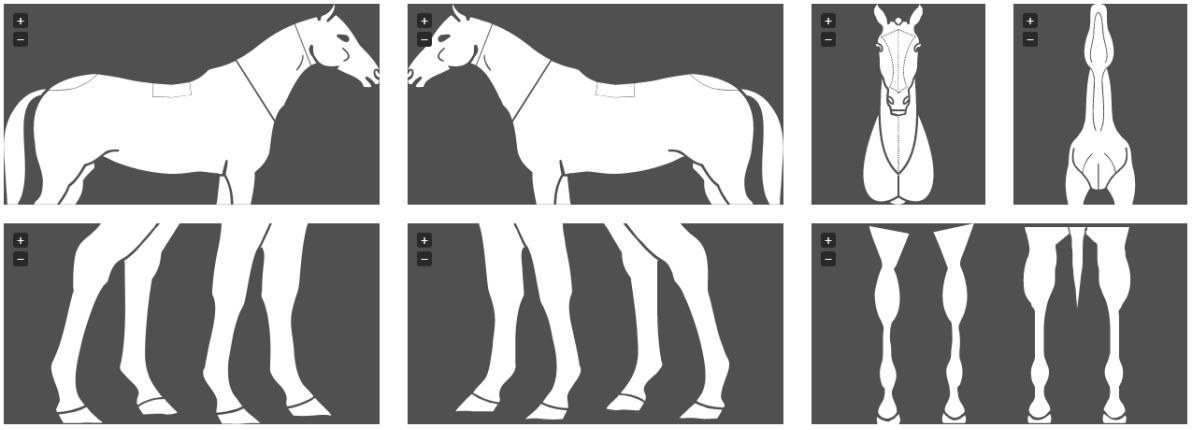

Figure 8: *Equine profiles that the veterinarian uses to identify animal particulars.*

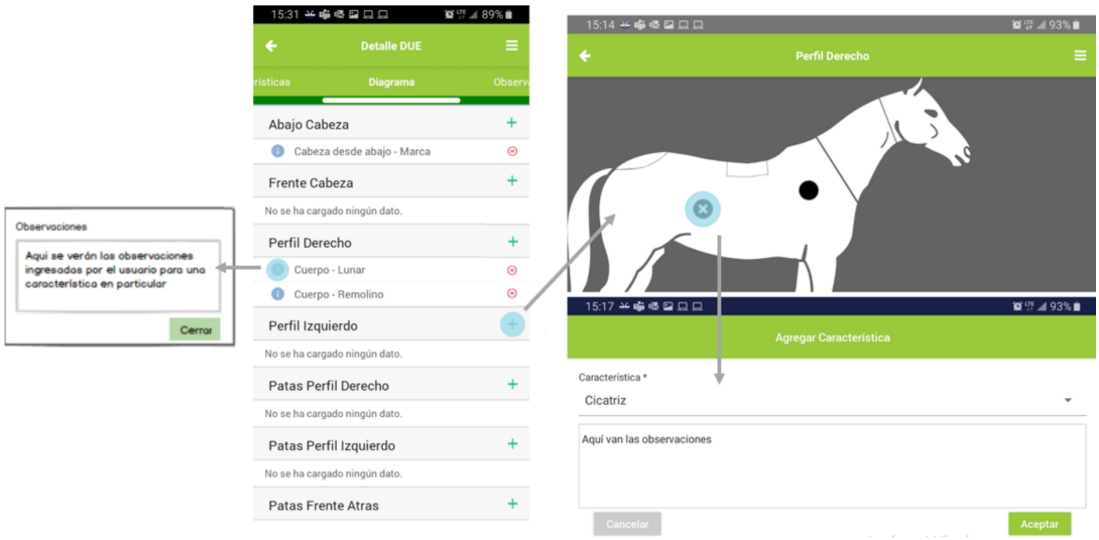

Figure 9: *Loading screen of the "diagram" in a DUE.*

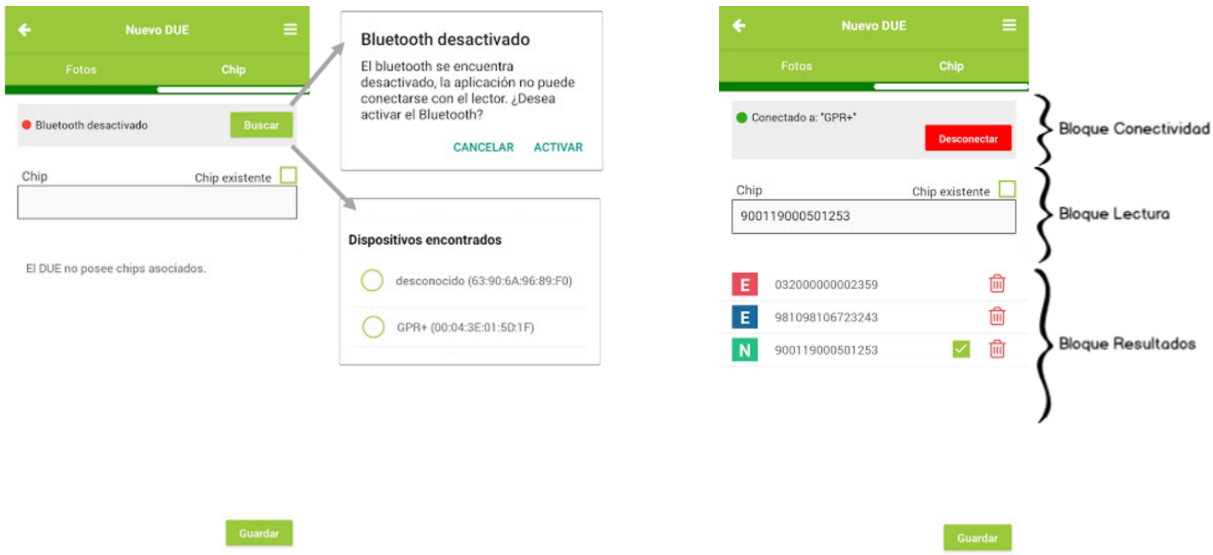

Figure 10: *Loading screen of the "microchip" for a DUE.*

It is also worth noting that this is something that did not exist in Argentina or the Province of Buenos Aires, which accounts for 50 percent of the country's agribusiness, and it is a great step forward towards the

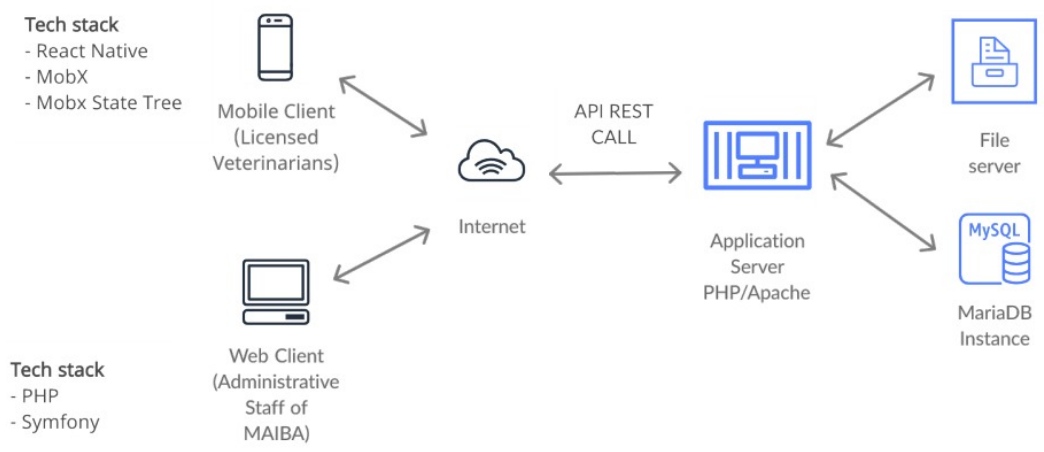

Figure 11: *General model of service-oriented architecture.*

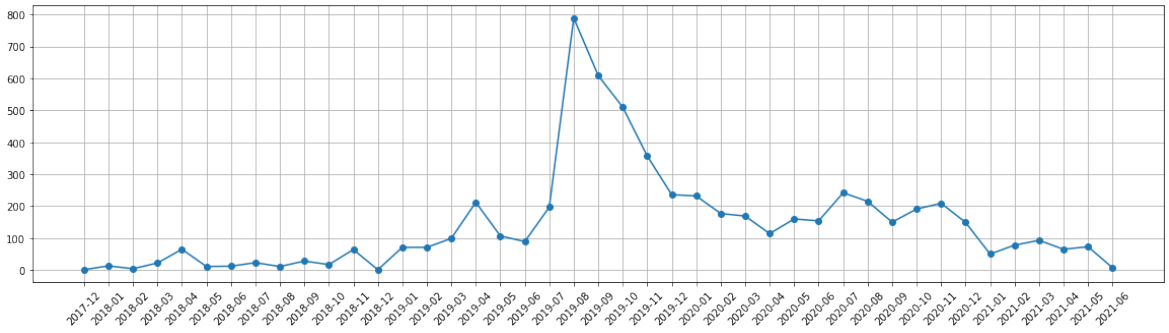

Figure 12: *Number of DUEs generated per month.*

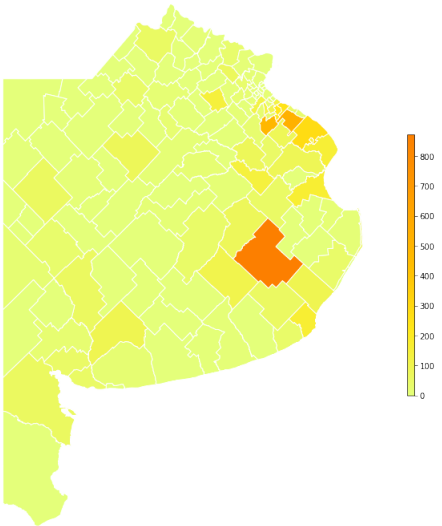

Figure 13: *Number of DUEs per district in the Province of Buenos Aires.*

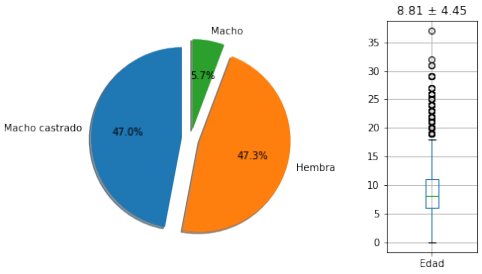

Figure 14: *Description of equine population: sex to the left and age to the right.*

modernization of the nation.

Finally, it is about a finished development. The mobile application can be downloaded from Google Play [16] and the MAIBA platform can be accessed through the Internet [17].

As future work, user interaction with equine profile "diagrams" could be improved. Currently, due to the restrictions of the libraries used, interaction is limited: users cannot zoom in or out or dynamically move the features once they are entered. In addition, it is expected to incorporate - as part of the synchronized data - the geographic location of the animal at the time of its registration.

On the other hand, as proposed extensions, a monitoring and report creation panel would be a good addition to the web application, allowing various filters to be applied on the map of the Province of Buenos

Aires to display statistical information. In addition, the design of an inspection module is being considered. This module would allow recognizing the microchip using the readers to immediately access the animal's data, leaving a record of the time and location of the control carried out.

Competing interests

The authors have declared that no competing interests exist.

Authors' contribution

This work has been presented by MOB as a dissertation to obtain the degree of B.Sc. in Systems from the National University of La Plata. This thesis was directed by LD and MH, with the added advice of AVM. All authors read and approved the final manuscript.

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