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Analysis and Implementation of a Satellite Tracking System applied to pets using free software with GPS and GSM technology

Análisis e Implementación de un Sistema de Rastreo Satelital aplicado a mascotas mediante software libre con tecnología GPS y GSM

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Abstract

The project aims to implement a satellite tracking system for pets, using GSM and GPS technology, free software and a VPS server. An analysis will be carried out to select the best GPS device. In addition, a mobile application will be developed that will allow users to see the geographic location of their pet and place virtual fences to prevent its loss. The application will also include additional options, such as the ability to configure the intensity of satellite tracking, call the device, and access a video tutorial and a menu of pet tips. The VPS server will host and route the satellite tracking software, and the mobile application will allow users to view their pet's location in real time and receive alerts if the pet leaves the geofence boundary. In summary, the project's main goal is to prevent pet loss and provide a useful tool to keep pets healthy and happy.

Keywords: GSM, GPS, SMS, APP, GPRS, VPS, Satellite Tracking, Google Maps
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Resumen

El proyecto tiene como objetivo la implementación de un sistema de rastreo satelital para mascotas, utilizando tecnología GSM y GPS, software libre y un servidor VPS. Se realizará un análisis para seleccionar el mejor dispositivo GPS. Además, se desarrollará una aplicación móvil que permitirá a los usuarios ver la ubicación geográfica de su mascota y colocar vallas virtuales para prevenir su pérdida. La aplicación también incluirá opciones adicionales, como la posibilidad de configurar la intensidad del rastreo satelital, llamar al dispositivo y acceder a un video tutorial y un menú de consejos para mascotas. El servidor VPS alojará y direccionará el software de rastreo satelital, y la aplicación móvil permitirá a los usuarios ver la ubicación de su mascota en tiempo real y recibir alertas si la mascota sale de la delimitación de la geocerca. En resumen, el proyecto tiene como objetivo principal prevenir la pérdida de mascotas y proporcionar una herramienta útil para mantener a las mascotas sanas y felices.

Palabras clave: GSM, GPS, SMS, APP, GPRS, VPS, Rastreo Satelital, Google Maps
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Introduction

It presents the necessary context, adequately describing the problem and justifying the need for the study. It is desirable to include quotations that reinforce what is stated by the authors. It is usually useful to make clear in this section the objective and contribution of the work carried out. Optionally, the organization of the article can be mentioned.

The project presented here aims to analyze and implement a satellite tracking system for pets using already known technology, such as GSM (Global System for Mobile Communications) and GPRS (General Packet Radio Service), for communication between the GPS device and the VPS (Virtual Private Server) server. This free software satellite tracking system will allow users to monitor their pets through a cellular application, which is particularly important in Ecuador, where technology for finding lost pets is scarce.

Although GPS technology has been widely used in many areas in Ecuador, including military, police, naval, maritime, vehicular, mining, medical, aerial and industrial, it has been little used in the veterinary field, specifically in pets. However, with the growing concern for animal welfare in Ecuador, including the approval of a law that punishes animal abuse with imprisonment which states the following: "Article 249 of the Organic Integral Penal Code states that whoever causes injury to animals of the urban fauna, causing permanent damage will be punished with imprisonment of two to six months and if the conduct is carried out as a result of animal cruelty or torture will be punished with imprisonment of six months to one year" (Council for the Protection of Animal

Rights of the District of Quito, Ecuador). (Consejo de Protección de Derechos del Distrito Metropolitano de Quito, 2022).. For this reason, the need has arisen for technological tools that allow pet owners to control their pets' location, especially in case of loss. The satellite tracking system implemented in this project will include customizable geocards to help pet owners keep their animals close.

A mobile application will be developed to allow users to register and modify relevant data about their pets, view their location in real time, receive notifications if pets go beyond the geofence, and view the history of their travels. The mobile application has been chosen due to its popularity, interactivity and ease of use. The database will be hosted on a VPS server, which is ideal for studio projects and small to medium-sized businesses, as it saves infrastructure, space and maintenance costs.

Since pets can be very restless, a self-adjusting collar with a lightweight and robust GPS device capable of withstanding weather conditions will be used. To limit the scope of the project and focus on an area with a high rate of pet loss, the city of Quevedo, located in the province of Los Rios, Ecuador, has been selected. Although it is a relatively small city, it has a large number of inhabitants according to the 2010 SENPLADES census which indicates the following: "Quevedo has 173.6 thousand inhabitants or 22.3% with respect to the province of LOS RIOS." (SENPLADES - National Secretariat of Planning and Development, 2014) and more and more people are joining animal welfare campaigns.

For the realization of this research work, other research works related to the use of GPS technology for pet tracking were analyzed, which were of great help for making the right decisions on the use of technologies and methodologies to be applied.

In the work of (Aguirre, Aguero, Landeo, & Wong, 2019)Geopet, a pet geolocator collar company, is created, which also has a geofence with which a perimeter can be established where the device cannot leave and in case it crosses it, an alert will automatically arrive to the owner's cell phone indicating in which direction he/she should go to look for it. However, the functions are not only focused on the locator, but also on providing users with something more, so it also has a social network where pet owners can interact and upload information about their dogs or cats. The main reason for the creation of Geopet was to reduce the loss of pets in the city of Metropolitan Lima and to maintain the safety of those who today are also a fundamental part of families. (Aguirre, Aguero, Felix, Landeo, & Wong, 2019)..

In the research of (Moltoni, Irurueta, Negri, & Duro, 2010) an evaluation of animal tracking collars based on GPS technology was carried out in Argentina, which allows the recording of movement to study animal behavior. The objective of this work was to evaluate the performance of the collar in the field, under conditions similar to those of a local production system. The collar consists of a battery-powered GPS collar that was placed on the animal and a base station in charge of downloading, wirelessly and automatically, the data from the collar. The collar recorded the position every 30 minutes and the base station was installed in the vicinity of the water trough. The device

proved to be robust and suitable for domestic production systems (Moltoni, Irurue, Moltoni, Irurue). (Moltoni, Irurueta, Negri, & Duro, 2010)..

The author (Basantes, 2016)conducted an analysis of technical feasibility and commercial viability of devices for locating canine pets through the use of GPS technology in the metropolitan district of Quito, through a GPS device placed as a collar on the pet, which was tracked through a cellular App and a GPS server. Helping the prevention of pet loss in the city of Quito. (Basantes, 2016).

In Ecuador currently the most used technology for pet tracking is the microchip, it has a size that resembles a grain of rice, which is implanted in the pet's back by certified veterinarians. This microchip contains vital information such as the pet owner's name, place of residence, age, medical history, among others.

One of its main disadvantages is that the implanted microchip is of passive Radio Frequency, that is to say, it will only show its information through an active RF (Radio Frequency) reader. Only veterinary medical personnel have them. Therefore, the chances of finding lost pets are very low.

Materials and methods

This research work is aimed at providing a technological service; therefore, the research methodology to be applied will be exploratory because information on similar cases will be sought. Descriptive because it will describe the process to be carried out based on the information obtained. Analytical because the information will be analyzed and from that it will be synthetic to determine the solution. The study population will be the canton of Buena Fe, which according to the last census has a population of 38,263 people in the urban area, due to the high number, a sample of 30 people will be taken, 15 women and 15 men residing in the canton.

The technique that will be used will be the virtual interview through Google Forms, since it is the fastest and safest way to obtain information from people due to the pandemic that is being experienced.

The interview technique will be carried out with the instrument called questionnaire which will be applied to the sample population through the WhatsApp application using a Google Forms link.

Results

Once the application was installed and configured, the following results were obtained:

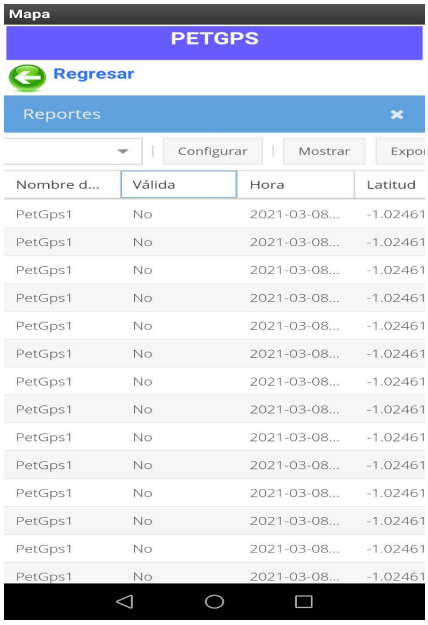
Once the Geofence has been created, you can visually appreciate the delimitation that the pet will not be able to cross, and if it does, an alert will be issued via web or email, the option via SMS is in the paid version of the Traccar platform.

Within the satellite tracking system, reports can be generated on several aspects such as:

- Route
- Events
- Travel
- Stops
- Summary
- Daily summary
- Graphic

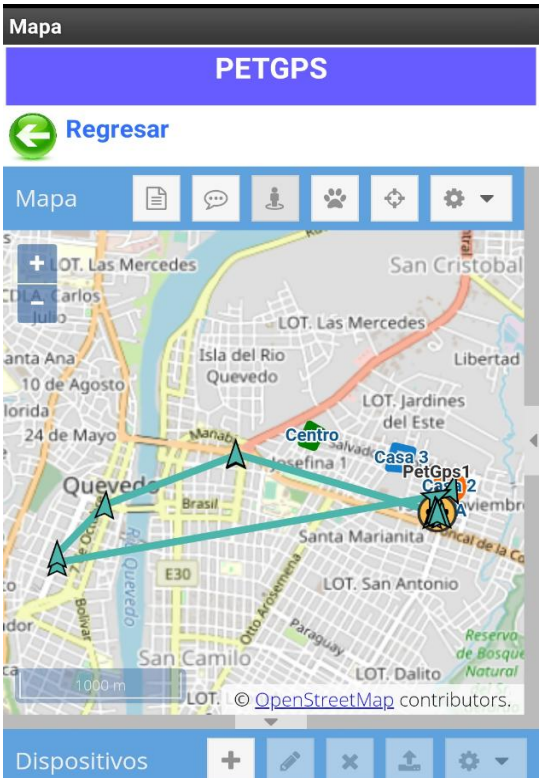
In this case a route report will be generated, which means the trajectory traveled by the pet, which can be done by date. To generate this report, click on the icon in the form of a leaf in the menu at the top, then choose the type of report, then in configuration the date you want to get the report, and click on the show button. After that you can close the report window and the route will appear on the date set on your device.

Figure 1. Route report generated



In the previous figure you can see the route report generated with its respective stops, which are the green triangles that indicate the periods of inactivity in movement of the pet with the GPS device. When lines are shown that do not match the roads or highways on the map, it is because the signal was lost.

Figure 2. Detection of the points visited by the pet.



As can be seen, the GPS device is in correct operation since it is able to be visible on the map and trace the route of established reports. In the hypothetical case that the GPS map of the PetGps application is failing, the user has the alternative of using the "Call" menu of the application in order to receive a link, which when clicked will open the Google Maps application with the location of the pet with the GPS device.

Figure 3. Google Maps link generated by the PetGps application.

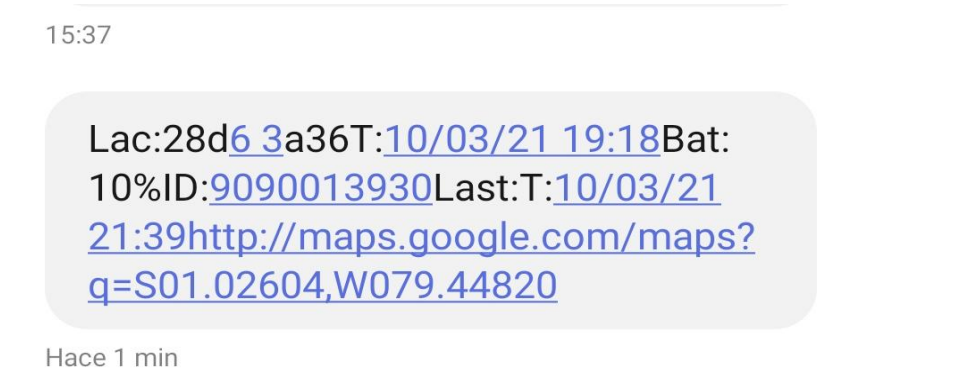
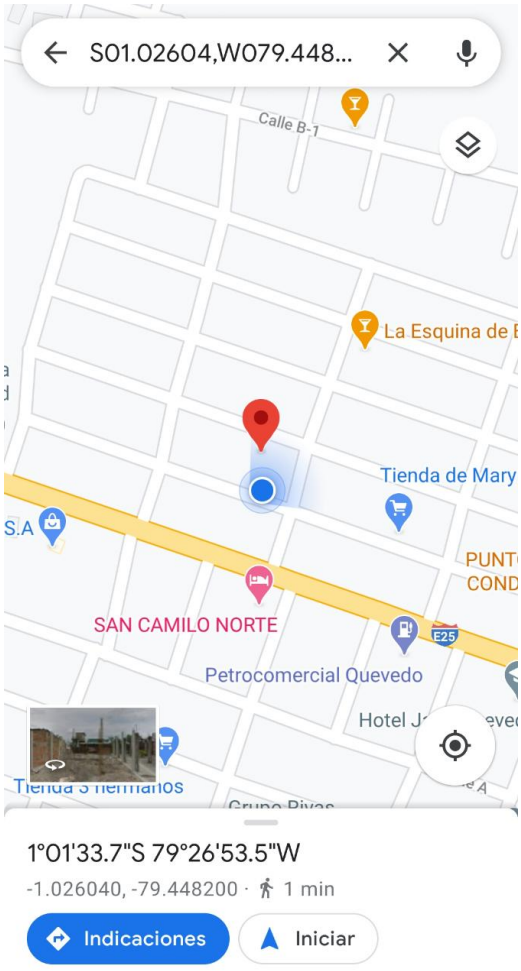


Figure 4. Location of the pet in the Google Maps application.



After completing the experimental study, satisfactory results were obtained. For example, they were able to provide pet owners with a technological tool that allowed them to have an effective control to prevent the loss of their pets through geofences or virtual fences. These geofences can send notifications by e-mail or phone call to owners when their pets leave their safe area. In addition, the satellite tracking platform enabled quick and efficient geographic location of pets in case of loss.

The results indicate that the satellite tracking platform fulfills its primary function, which is to prevent and find pets in cases of loss. However, the study also pointed out some aspects that need improvement. For example, it is proposed to develop a mobile application that is compatible with IOS operating systems and to program push alerts within the mobile application so that users can be alerted more quickly. In addition, it is suggested to improve the aesthetic design of the application and create an accessible version for people with visual impairments or disabilities. Finally, it is necessary to develop a more economical GPS device prototype, since the device used in the experiment has a high cost and is in short supply in Ecuador.

In summary, the results of the pilot study are satisfactory and demonstrate that the satellite tracking platform is a useful tool to prevent and find pets in cases of loss.

However, it is necessary to work on specific improvements to enhance the functionality and accessibility of the platform.

Conclusions

The characteristics of different types of open source GPS platforms were analyzed and the Traccar platform was chosen as the best in performance and reliability. The characteristics of different types of GPS equipment adaptable to pets were analyzed and the TKStar TK909 device was chosen as the best in terms of performance, functions, weight and cost. The VPS server was used and configured on the DigitalOcean cloud server with the open source GPS Traccar platform, where the acquired data was stored.

A cellular App was created and designed in MIT APP INVENTOR named PetGps, in which the data obtained from the VPS server emitted by the Traccar platform can be visualized thanks to the data received by the TKStar 909 device that rests on the pet's neck.

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