

GEOGRAPHIC INFORMATION SYSTEMS FOR THE MANAGEMENT OF PUBLIC PARKING FEES

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SUMMARY

The main objective of this titling work is to develop a Geo-Referenced System to support the Management of the Municipal Rotating Parking System (SIMERT) of the Municipality of Ambato, with the purpose of contributing to the management of the SIMERT department through the development of a geo-referenced computer system. The methodology applied in the present research is descriptive, correlational, quantitative and qualitative, due to the characteristics of both the dependent and independent variables. Therefore, for the collection of primary and secondary information, the research instruments were applied to 56 Public Servants who work in the SIMERT department, as well as direct observation was developed to obtain information regarding parking spaces and the current management of the aforementioned dependency. As a result of the tabulation, analysis and interpretation of the information, we proceeded to develop in the ArcGis Software the Geo Referencing of the parking spaces, which will be connected to the Park Sys System, allowing SIMERT administrators to have real-time information on occupied parking spaces and those that are available, in order to improve the management they carry out. Finally, in the present work, the feasibility analysis is reflected, in which the technical verification of the system is established, as well as the financial and environmental evaluation.

KEYWORDS: <Simert>, <estacionamiento Tarifado>, <system Georeferenciado>, <SIG>, <Gestión>.

ABSTRACT

The main objective of this certification work is to develop a Geo-referenced System to support the Management of the Municipal Tariff Switching System (SIMERT) of the Municipality of Ambato, with the purpose of contributing to the management of the SIMERT department through the preparation of a geo-referenced computer system. The methodology applied in this research is descriptive, correlational, quantitative and qualitative, by the characteristics of both the dependent and independent variable. Therefore, for the collection of primary and secondary information, the research instruments were applied to 56 Public Servants who work in the SIMERT department, as well as the direct observation to obtain information regarding parking spaces and management. current of indicated dependency. As a result of the tabulation, analysis and interpretation of the information, the Geo Reference System of the parking spaces was developed in the ArcGis Software, which will be connected to the Park Sys System, allowing the

SIMERT administrators to have information in real time occupied parking spaces and those that are available, in order to improve the management they perform. Finally, in the present work, the feasibility analysis is established, in which the technical verification of the system is established, as well as the financial and environmental evaluation.

KEYWORDS: <Simert>, <Tariff Parking>, <Geo-referenced System>, <SIG>, <Management>.

INTRODUCTION

The Directorate of Transit, Transport and Mobility of the Decentralized Autonomous Government Canton Ambato, is the entity responsible for ensuring sustainable and quality mobility for all inhabitants of the city of Ambato, for this it has different departments in charge of the different problems in terms of traffic, one of its departments is the department of Municipal Rotating Parking System (SIMERT), The same one that seeks the good use of public parking lots in the central part of the city, to thereby help road decongestion.

For the support to the management of the SIMERT department, it was determined the need to develop a Geo referenced System, which reflects the exact places where the parking spaces are located, this being a technological tool that collaborates with the personnel working in said department for the fulfillment of its objectives.

This is how the present research work arises, whose purpose is to provide a Geo-referenced System that helps improve the Management of Rotating Parking Fees.

The development of this document describes the methodology of applied research, the analysis and the main results obtained as a result of the application of research instruments, for the development of the Geo referenced System that helps improve the Management of Rotating Parking Fees.

METHODOLOGY

According to the Research Methodology, it is considered and (Rodríguez, 2012) defined as the discipline that elaborates, systematizes and evaluates the whole of the procedural technical apparatus available to Science, for the search of

data and the construction of scientific knowledge. The Methodology is a set of techniques and procedures whose fundamental purpose aims to implement processes of collection, classification, validation of data and experiences from reality, and from which scientific knowledge can be built.

Accepting what was pointed out by (Rodríguez, 2012), it is defined that this research is non-experimental, field, documentary – bibliographic; of inductive-descriptive type; the scope of the research is correlational of qualitative and quantitative approach, of an objective nature, because the collection of statistical and numerical data was used, through which measurements can be made, analysis until being able to conclude with the establishment of the Geo-referenced System that helps to improve the Management of Rotating Parking Fee.

For which, it was established that the study population is constituted by the personnel who work in the SIMERT Department, of the Municipal GAD of Ambato, giving a total of 56 people divided into:

- - 1 SIMERT administrator
- 1 Park Sys System Manager
- 8 Motorized
- 46 Supervisors

It is defined that the sample size is the same study population, that is, 56 Public Servants who work in the Department of the Directorate of Transit, Transport and Mobility; by virtue of the fact that it is a finite value, and does not require that a portion or segment of it be extracted, because it is a not high and limited numeric.

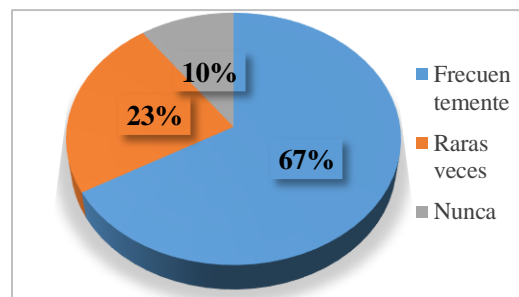
To which the interview and surveys were applied for the collection of primary information required for the development of the research, as well as observation sheets.

ANALYSIS AND INTERPRETATION OF RESULTS

After the analysis of the information collected in the field, the most relevant information obtained is detailed:

67% of respondents say that there are often difficulties in parking areas, especially in relation to the city's shopping center, which is precisely

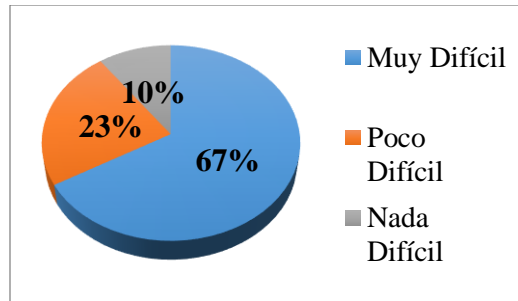
where most of the population goes to comply with the execution of their procedures. Percentage that reflects the great problem that encloses the parking system especially in office hours, which is where the greatest influx of users can be observed throughout the city center and the places where the main public and private institutions are located, which is where people go generally and daily. 23% say that they have rarely suffered any kind of difficulties with the parking system, however, this does not mean that the problem is not present. On the other hand, 10% indicate that they have never had this problem, a situation that suddenly has to be related to the work area they perform, that is, their functions are not directly related to users who require a parking lot at the right time.



Source: prepared by authors

In the results obtained it can be evidenced that the greatest problem presented by users experiences time problems in the search for parking spaces in the city of Ambato, especially in the center of the city. 80% of the staff states that this is precisely the biggest problem that arises at the moment when people need spaces to park their cars. On the other hand, 10% affirm that they have problems with the cost involved in parking, compared to 10% who have problems in spaces, that is, difficulties in parking their cars either because of their size or because the other vehicles are poorly parked.

In the question posed, it can be seen that 67% of respondents state that it is very difficult for them to know and learn the codes that are handled in the Municipal Integrated System of Rotating Parking Rates that is applied in the city of Ambato. On the other hand, 23% of respondents indicate that learning codes is a bit difficult, a situation that can also be the product of the time spent in the job or the ability of the official in the management and interpretation of them.



Source: prepared by authors

90% of respondents consider it very necessary to have a Geographic Information System to facilitate the management of the SIMERT Department. This will contribute to improving the actions that are fulfilled within it. On the other hand, 10% consider the existence and implementation of such a system necessary, percentages that simply confirm the need to look for alternatives that improve the obtaining of information and the updating of codes, among others.

The following information was obtained from the observation sheets:

- ✓ 141 Blocks with their respective streets, intersections and Codes.
- ✓ 139 Tariff Blocks, that is, the block where parking is charged, with data from Codes and streets that intersect them.
- ✓ 1294 parking spaces, that is, the specific place that a vehicle uses to park, with its respective codification.
- ✓ 125 Points of Sale, with information such as name of the premises, address and the block to which it belongs.

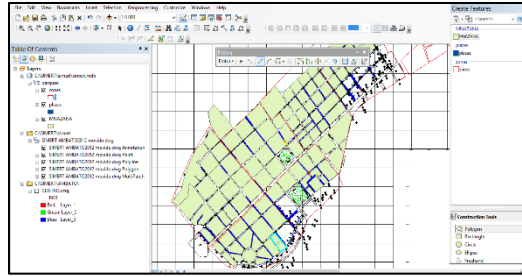
GIS DEVELOPMENT

The System itself works with a complete database containing geographic information, which is associated by a common identifier to the graphic objects of a digital map. Thus, when pointing to an object, you will be able to know its attributes and at the same time you can immediately know its location.

The management of spatial information, allows to separate the information in different thematic layers and stores them independently, thus allowing to work with it in a fast, simple and timely manner. The professional in charge of its management and application will have the possibility of relating the existing information with the different graphic elements that represent the geographical characteristics and their position within a map.

MAP LAYOUT

Before making use of the information collected, you must first design the map in the ArcGIS software, taking into account the geographical location and the measurements of the figures to be drawn, which in this case are the fare blocks, fare blocks, parking spaces, and points of sale.



Source: prepared by authors

Map data entry

Once the map design is done, the data corresponding to each element must be entered,

obtaining the following tables with their respective attributes:

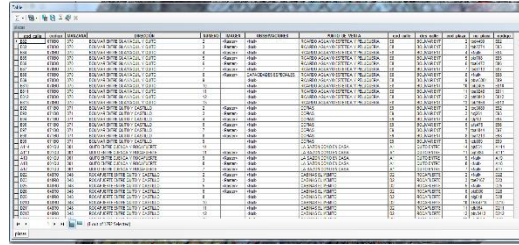
MANZANA	ZONA	Areas Tarifadas	DIRECCION	REFERENCIA	OBSERVACIONES
001	1	1	QUITO ENTRE CUENCA Y ROSAFUERTE	LAS CLINICO SAN IGNACIO	< > >
002	1	1	CUENCA ENTRE MALDONADO Y ROSAFUERTE	PATIO DE CARROS CAJEC	< > >
003	3	0	CUENCA ENTRE HERRERA Y MONTALVO		< > >
034	6	0	CUENCA ENTRE AYLLON Y VARGAS TORRES		< > >
035	6	0	CUENCA ENTRE MANUELA CAÑAZARES Y AYLLON		< > >
036	6	0	CUENCA ENTRE MANUELA CAÑAZARES Y MALDONADO		< > >
037	5	0	CUENCA ENTRE FERNANDEZ Y MALDONADO		< > >
038	5	0	CUENCA ENTRE TOMAS SEVILLA Y FERNANDEZ		< > >
039	5	0	CUENCA ENTRE ELOY ALFARDO Y TOMAS SEVILLA		< > >
040	5	0	CUENCA ENTRE ESPEJO Y ELOY ALFARDO		< > >
041	5	0	CUENCA ENTRE ESPEJO Y LALAMA		< > >
042	3	1	MARTINEZ ENTRE CUENCA Y ROSAFUERTE	FRANJERIA	< > >
043	3	0	CUENCA ENTRE HERRERA Y MARTINEZ		< > >
044	3	2	MONTALVO ENTRE CUENCA Y ROSAFUERTE	SALGA A FOGA	ABRILACION
045	1	0	ROSAFUERTE ENTRE CASTILLO Y MONTALVO		< > >
046	1	1	CASTILLO ENTRE CUENCA Y ROSAFUERTE	CAFETERIA MARCELOS	< > >
047	1	1	ROSAFUERTE ENTRE QUITO Y GUAYAGUIL	HOTEL AIBATO	< > >
048	1	2	ROSAFUERTE Y CASTILLO		< > >
049	1	2	MONTALVO ENTRE ROSAFUERTE Y BOLIVAR	CAJAS DE COMERCIO	< > >
050	3	1	HERRERA ENTRE ROSAFUERTE Y BOLIVAR	CONTRALORIA GENERAL DEL ES	SITO PROHIBIDO
051	3	1	ROSAFUERTE ENTRE HERRERA Y MARTINEZ	CLINICA LARBA	< > >
052	3	0	LALAMA ENTRE BOLIVAR Y ROSAFUERTE	CENTRO CULTURAL EUGENIA NE	SITO PROHIBIDO
053	3	0	ROSAFUERTE ENTRE MARIANO EUSEB Y LALAMA		< > >
054	3	1	ROSAFUERTE ENTRE MARIANO EUSEB Y ESPEJO	LICED MONTALVO	< > >
055	5	0	COLON ENTRE ELOY ALFARDO Y ESPEJO		< > >
056	5	0	COLON ENTRE ELOY ALFARDO Y TOMAS SEVILLA		< > >
057	5	0	COLON ENTRE TOMAS SEVILLA Y FERNANDEZ		< > >
058	5	0	COLON ENTRE FERNANDEZ Y MALDONADO		< > >
059	6	0	COLON ENTRE MANUELA CAÑAZARES Y MALDONADO		< > >
060	6	0	COLON ENTRE MANUELA CAÑAZARES Y AYLLON		< > >
061	6	0	COLON ENTRE AYLLON Y VARGAS TORRES		< > >
062	6	2	ROSAFUERTE ENTRE VARGAS TORRES Y AYLLON	BAZAR Y JOQUETERIA	< > >
063	6	2	ROSAFUERTE ENTRE MANUELA CAÑAZARES Y AYLLON	COO LA MERCED	< > >
064	6	2	ROSAFUERTE ENTRE MANUELA CAÑAZARES Y MALDONADO		< > >
065	5	2	MALDONADO ENTRE BOLIVAR Y ROSAFUERTE	FARMACIAS ECONOMICAS	< > >
066	5	3	FERNANDEZ ENTRE BOLIVAR Y ROSAFUERTE	CLINICA SAN JACINTO	< > >
067	5	2	ELOY ALFARDO ENTRE ROSAFUERTE Y BOLIVAR	EL ARROPE	< > >
068	5	1	ROSAFUERTE ENTRE ESPEJO Y ELOY ALFARDO	CLINICA SAN SEBASTIAN	< > >
069	1	2	BOLIVAR ENTRE FANOSCO FLOR Y GUAYAGUIL	INSTITUTO LICEO CEVALLOS	< > >
070	1	1	BOLIVAR ENTRE GUAYAGUIL Y QUITO	UNIVERSIDAD ROCHAMERCA	< > >
071	1	1	BOLIVAR ENTRE CASTILLO Y QUITO	ANDINTEL	< > >
072	1	0	BOLIVAR ENTRE CASTILLO Y MONTALVO	PARQUE MONTALVO	SITO PROHIBIDO
073	3	0	BOLIVAR ENTRE MONTALVO Y HERRERA	BANCO NACIONAL DE FOMENTO	SITO PROHIBIDO

Source: prepared by authors

Relationship of data entered with data from the Park-Sys system

For the elaborated map to comply with the expected and its function, it must be linked to the Park-Sys computer system, so it is necessary that once the map is prepared, the data relationship is elaborated.

In the ArcGIS software, these relationships are made with the "Join" function, in which, in the case of this project, the table of Priced Squares was related to the "Streets" table of the Park Sys system.



Source: prepared by authors

Technical Feasibility / Verification of Operation

Verification of concordance of the map data prepared with the reality in the field, verifying that using the information of the map a real idea of the situation is obtained for support in management and decision making.

This procedure was carried out through the connection of the Park Sys system to the ArcGIS software, in which the supervisor is an essential part of the program, since it will be he who enters the information in real time, feeding the computer platform, for which he will perform the following:

The coding of the tickets will be entered in the Park Sys program, prior to their distribution, where those that are lasting one hour and those that are lasting half an hour are identified.

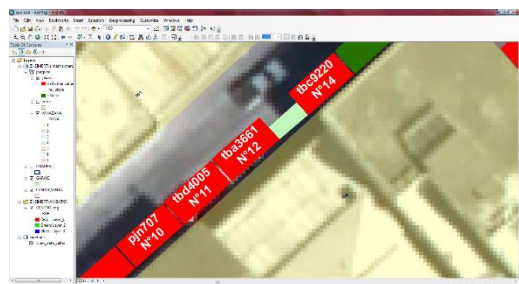
The supervisor will verify the occupied place, for which he will register in the Park Sys program, by means of a message, detailing the ticket code, the location (which will be reflected automatically through geographical coordinates), in case a vehicle leaves the square, the supervisor must report it through his cell phone.

The Park Sys program will continue to operate the way it does today, with the difference that it will allow alerts to be sent to both supervisors and motorized vehicles, based on the address and geographical coordinates of possible offending vehicles, but no longer in codes.

The administrator will be able to observe on his screen the figure No. 7-4, in which it is observed, in real time, the occupied places and the empty or free places, who will have the power to control the operation from this new system, asking the personnel in the field the corroboration of the information with which he has on the screen, This way you can also detect possible infractions, asking the motorized or supervisors to approach the point to confirm it.

Therefore, there will be no need to handle location codes, because having the geographical coordinates and the exact address will eliminate the confusion that exists today.

Once the operation of the program has been verified, through a field test, it is considered technically feasible to implement the program under study.



Source: prepared by authors

Implementation Category

The value required for the implementation of the program is \$ 47,729.45, value that includes the acquisition of parking tickets, excluding this value, which is contemplated in the budget of the Directorate of Transit, Transport and Mobility, the value for the final concept of the program is \$ 21,020.00 per year, for its correct operation.

It should be noted that this investment will be recovered, product of the improvement in the correct control through the program, that is, continuously and permanently verifying the vehicles parked in the parking areas fee, as well as the monitoring of the maximum time allowed to park in the same parking space, which will generate the increase in ticket sales, of which an increase of 1.33% of tickets sold is considered, maintaining the relationship of 2017 and 2018.

Environmental impact

product of the application of the environmental factors, components and parameters that contemplate the Leopold matrix, it is considered that the importance corresponds to 15.6%.

Social viability

By allowing the user to access their destination quickly, finding accessible parking spaces, it allows a saving of time, as well as kilometers of driving in search of a parking place, which translates into fuel savings in the economy of the owner of the vehicle, particular that contributes to the reduction of the consumption of non-renewable resources.

On the other hand, it allows to generate a greater incentive in the local economy, since the user, having facilities to reach the center of the City, which is characterized by its high dynamization in commerce, is encouraged to transit it and at the same time to make their daily purchases in a certain sector of the city, particular that benefits the merchants of this area.

CONCLUSIONS

Currently, the Department in charge of the Municipal Rotating Parking System of the City of Ambato, is managing 1,294 parking spaces distributed in 139 zones, whose use has the value of \$ 0.40 per hour and \$ 0.20 per half hour, allowing a maximum time of two hours of parking in the same square; with 8 motorized and 46 supervisors for the control and operation of the System, however, it was detected that this activity is carried out manually, without having a record of the data, nor an updated information base, preventing an adequate and correct control on the road, since it was possible to detect that there are vehicles that park within the fare zone without purchasing a ticket, as well as vehicles that exceed the maximum time allowed.

In the present investigation it was possible to establish the critical points in the management of the System, among the main ones is the lack of operational control, there is confusion of the codes that indicate the location of a square, since both motorized and supervisors do not manage to identify them, because they do not attend the alerts or warnings of the program, generating that users evade the acquisition of tickets and payment of fines.

Through the ArcGis software, the necessary Georeferencing tools have been established, which have been effectively connected to the Park Sys program, allowing the correct and adequate control by the supervisors and motorized, in addition to this, this product has allowed the administrator to have total control over the system.

RECOMMENDATIONS

It is recommended to keep updated the information involved in the Rotating Parking System Fee, both of the existing spaces, the margin of occupation of the same, as well as the percentage of rotation of these, taking into account extensions and reductions of parking spaces, it should be noted that there must be a source of data that allows to be actively feedback.

It is necessary to make a continuous evaluation of the Rotating Parking System, since it must continue to analyze the critical points presented by the management, so that they can be resolved in time so as not to allow setbacks to be generated in the System.

It is important to continue advancing with the study and analysis of the Geo Referenced Map, since it has several tools that can be very useful according to the problems and needs presented by the management. In addition, a periodic control of the operation of the Geo-referenced Map must be made, that is, to verify that what the map presents us is the reality of what happens in the streets. Finally, it is pointed out that the management of a fee-based parking system needs several elements for good management, for example a parking meter system for the sale of tickets, parking places in buildings, payment of fines through electronic transfers, purchase of tickets through cell phones, and an updated map that indicates the reality of parking sites, that will help management and decision making.

<https://www.lifeder.com/marco-referencial-de-investigacion/>

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