Teleagro: Software Architecture of Georeferencing and Detection of Heat of Cattle

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Abstract. The systems of livestock production contribute in a preponderant way to improve the quality of life of the communities, since it allows to support the production of the daily sustenance of the communities, to conserve the ecosystems, to promote the conservation of the wild life and to satisfy the values and traditions cultural Latin America, with its large wilderness areas, and a privileged climate favors the maintenance of livestock, to meet the demands of food and ensure regional and global food security. In Colombia, the agricultural sector contributes approximately 11.83% of the national GDP at current prices, according to the Bank of the Republic. Likewise, the livestock industry participates with 3.6%, in comparison with other sectors of the agricultural economy, the production of Colombian cattle doubles and triples to other sectors, such as poultry, coffee and floriculture. In addition, it contributes to the generation of employment in more than 25% of the total jobs generated in the agricultural sector and approximately 7% of the total employment of the Colombian economy (http://www.banrep.gov.co/is/pib). Within agricultural production, livestock occupy 38 million hectares, being 9 times larger than the area dedicated to agriculture. However, agriculture contributes 63% of the value of agricultural production, while livestock, mainly extensive, contributes 26% (FEDEGAN, Strategic Livestock Plan 2019). The large proportion of the area with agricultural vocation dedicated to precarious extensive livestock has explained the low agricultural productivity in Colombia, with very serious consequences for human and sustainable development. This document shows the results of the communications, software and hardware platforms to help the livestock sector to manage production.

Keywords: Tecnhnological system · Georreferenced detectioni ·
Zeal of bovine cattle

1   Introduction

An indicator of productivity that allows making comparisons is the extraction rate and the percentage of the herd that is sacrificed. In Colombia it is approximately 14%, a value that has remained stable in recent years, indicating the few advances in productivity. This rate is well below the world average of 21%, and even more against countries such as Argentina 25% or the United States 38%. If the extraction rate in Colombia were equal to the world average, it would produce more than five million heads per year, instead of the nearly four million that are currently slaughtered; and if the extraction average were that of Argentina, more than six million heads would be produced per year for slaughter [1].

The bovine cycle can also be taken as an indicator of the technological level of the activity. The greater the duration of the cycle, the lower the technological level and the profitability of the livestock activity [2]. Econometric measurements of the livestock cycle in Colombia show more marked and deeper cycles than other herds, and have shown that from the moment the gestation begins until the steers are slaughtered there is a period of five years, which reflects a period of maturation of very extensive investment.

Regarding investment in the agricultural sector, there are "growth bottlenecks" that inhibit investment in the agricultural sector, such as insecurity, lack of definition of property rights, inadequate infrastructure, lack of innovation and development technology and the lack of access to financing, among others. With a view to the future in the short and medium term, it is worth asking how the Colombian agricultural sector can take advantage of the opportunity of the high prices of agricultural commodities in international markets and the entry into operation of Free Trade Agreements signed by the country, to make a leap in production and productivity, taking into consideration principles of economic, social and environmental sustainability [3].

Economic sustainability refers to the fact that the sector must be able to generate income based on the comparative and competitive advantages of its productions; [4] Social sustainability refers to the fact that the income generated by the sector must be at least sufficient to guarantee a decent life for all farmers in the field, and environmental sustainability refers to the fact that agricultural activity must preserve the environment.

The article is organized in the next section. First, the problem of livestock sector in Colombia is shown. Second, we explain the software applications. Third, each of the components of the hardware architecture is detailed. Fourth, the conclusions of the experimentation are shown and future works. Finally, the researchers thank all those who supported the development of this project.

2   Problems of Livestock Sector in Colombia

Livestock producers in Colombia represent 80.7% of the farms currently [5] in the department of Cesar. It is important to define that this production is fundamentally based on family-type production. The small livestock production can and generates an important part of the necessary food for the internal market of the department. The family or backyard livestock production contributes to the growth of the gross domestic

product, could help boost exports of livestock products, generates jobs, besides being a source that generates nutrients for consumption and is a key factor in the fight against insecurity food and sustainable. rural development.

The potential contribution of this sector to the agricultural economy of the Department of Cesar and to food security depends, in most cases, on the timely receipt of animal and veterinary health services, technical assistance and other support needed for guarantee sustainability of their production systems. Small-scale producers require not only access to better and new technologies, but also innovations in production systems that guarantee their access to markets and improve the contribution of self-consumption to the requirements of diets [6, 7].

Livestock can also protect households from crises such as those caused by drought and other natural catastrophes. Possession of animals can increase the ability of households and individuals to fulfill their social obligations and improve cultural identity.

Livestock is also a basic source of guarantees for the poor and allows many households to obtain access to capital and loans for commercial purposes. Thus, livestock is an important asset of capital that, with careful attention, can give a boost to households to get out of extreme poverty and benefit from market economie, the incentives for investment in any industry are given in the security of recovery and generation of profit from the resources invested and combined with a return in the short and medium term of this investment, when in the bovine production the adequate techniques are not used to production, the return on investment is slow and in the department of Cesar [8], this slow return has traditionally been managed especially in the small producers who represent the majority in the sector.

On the other hand, insecurity in the region, kidnappings, extortion, cattle rustling and armed conflict, do not provide the guarantees to increase investment in the cattle production of the department, so in the last decade, investment in the sector in the department has been decreasing [9]. The small producers of the cesar department do not have the economic capacity to access the technologies that have already been developed and successfully tested in bovine production, which does not allow them to compete with the producers who have access to them, so that every day its profitability decreases, the lack of technological resources, technical assistance and capacity to take on challenges such as those of climate change, increasingly opens the existing gap in the region. The efficiency of a productive sector is measured at the regional level by the capacity to supply the domestic market fully and generate surpluses that allow it to export, currently Colombia has three free trade agreements that would allow it to export meat, with the United States, the European Union and Canada, however we are talking about economies with a sector of bovine production technified, in some cases with the basket compensated, or subsidized production, with a superior infrastructure and an exchange rate in its favor, therefore the technological backwardness in the department the possibility of accessing international markets would be increasingly remote.

One of the causes of the crisis of livestock in the department of Cesar is the productive cycle of a cow, which includes all the phases and events through which the cows pass, between a birth and the next birth, to reduce to the appropriate minimum, it is necessary to perform heat detection efficiently, which requires a visual observation of certain behaviors that the cows present during this period, which does not guarantee the

success of this, which has placed the periods open in the department months, when a cow under normal conditions its open period is 12 months. With the decrease in the open period, the small producer would obtain a profit of approximately 680 thousand pesos per year, by incorporating the technology for the detection of heat and with a percentage of efficiency of 50% of the cattle females of the cattle inventory of the region. Amounting to 500 thousand copies, annual income for producers would amount to 170 billion pesos, which represents 1.6% of the GDP of the department [10].

Although there are technological solutions, small producers in the department of Cesar have several obstacles to a greater use of information technology. These include the following: insufficient development of communications infrastructure; high costs of acquiring computers, telecommunication equipment and related computer programs, as well as the costs of exploiting communications; deficiency of human capital to develop and manage new technology, and lack of a private market capable of offering infrastructure, developing computer programs and promoting applications. On the other hand, the investment costs in technology is affected by the fear of the investor for the insecurity that plagues the country's fields, are factors that undoubtedly affect sustainable growth of livestock, one of these manifestations of insecurity is that of cattle rustling or cattle theft, according to the National Federation of Cattle Ranchers-FEDEGAN, The municipalities with the highest incidence of cattle theft, after Valledupar, are Codazzi, La Jagua de Ibirico and Astrea. It is a recurring theme, there are times when it increases, in others it decreases but it has never stopped showing up [11].

The research and transfer of technical knowledge and processes to producers and workers of livestock companies, are fundamental pillars for regional development and would be crucial to solve the problems of the sector, however for the department of Cesar, no research has been conducted that seek to reduce the cost of computer applications that could generate an impact on productivity and that are accessible to small producers, who represent the majority of the population dedicated to livestock production. With the development of a technological product commercially accessible to small producers, in addition to the contribution to economic development, a viable and scalable enterprise will be generated [12].

The present article shows the results of a project that was framed in the national public policies, this is how in the document bases of the National Development Plan "All for a new country", it is indicated as the objective of the national government To promote the inclusive economic development of the country and its regions, To achieve a more equitable and inclusive society through a greater articulation between the policies of economic development and those of social development. It seeks to enhance the contribution of Science Technology and Innovation in the development of business initiatives that contribute to reducing the gaps of the population.

The same objective points to the need to strengthen agricultural competitiveness to consolidate the countryside as a generator of employment and wealth for rural inhabitants. In order to increase rural productivity and profitability, it requires the provision of sectoral goods and services, as well as integral interventions in the territories, that allow optimizing production conditions, consolidating domestic markets and taking advantage of access to new markets. One of the strategies achieved in the document is to implement a system of comprehensive technical assistance, which is

articulated with the National Agricultural Innovation System and has as a starting point the needs of producers and market conditions.

The low productivity of the agricultural sector and the gaps between agricultural research and technical assistance, explains in part the low effectiveness of technological packages in the sector. The pillar that supports the productivity of agricultural activity is the research and transfer of technical knowledge and processes to producers and workers of livestock enterprises.

With the transfer of technology to the sector we have an opportunity, a resource and we must work in this line, technology is the engine of change and every future scenario must be thought in terms of human development, social, economic and environmental sustainability.

3   Software Architecture of Teleagro

This section provides information on the infrastructure architecture of the platform that will be used for the implementation of the TELEAGRO project See Fig. 1.
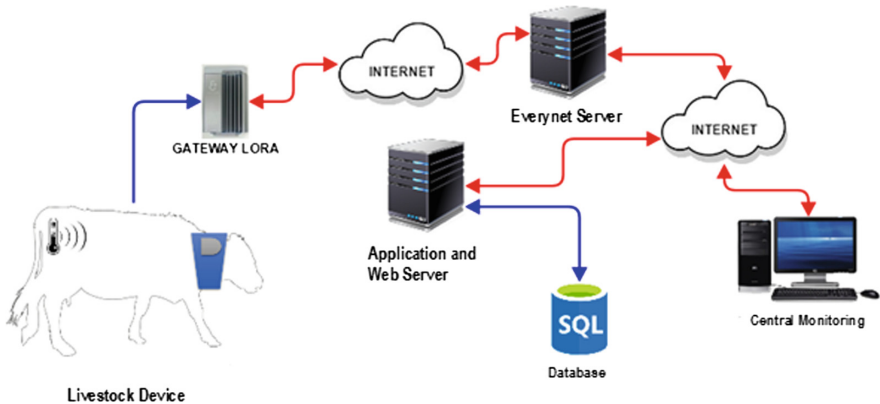

Fig. 1. General operation of the solutions

3.1   Local Operation of the Solution

Each animal will have an intrauterine device that will monitor the temperature of the cow and wirelessly transmit the data periodically and/or event, it must have an energy autonomy of the same duration of the main device located on the neck of the animal, from which it will be sent to the server along with the other parameters or variables. See Fig. 2.
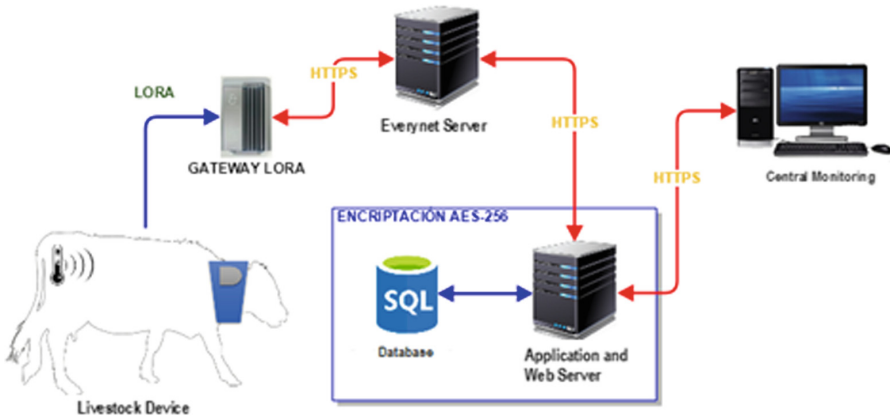
Fig. 2. Local operation of the solutions

3.2   Description of Components

- **Devices:** Electronic devices that will monitor livestock status. The devices will have an RF interface that will allow them to connect to the Lora Gateway, which sends the data to the Everynet server so they can be consulted and stored in the central database.
- **Monitoring Server (Application):** Server that contains the service that will be in charge of consulting the information of the Everynet servers and sending the data to the monitoring center.
- **Central database:** Server where the information of the platform in general, the different guilds, productive units, farms and all their configurations will be stored. It will also store the information that is monitored from the pomegranate and the alarms that could be generated.
- **Web Server:** Server where the web application of the monitoring center will be hosted. In the application the monitoring of the livestock of each productive unit will be carried out as well as the visualization of the alarms that may be generated. In addition to all the basic functionalities of the platform.
- **Server Application:** Corresponds to the instances where the services that update the monitored values of the animals are kept in real time. Initially this scheme will support up to 20,000 devices (cattle) reporting approximately every 15 min.
- **Database:** Corresponds to the instance where the database system that supports the platform is hosted. Initially it will support 20,000 devices (cattle) reporting approximately every 15 min.

4   Results

The transmission of the data that is collected through the devices through LORA protocols are sent by the Lora Gateway through the HTTPS protocol with Authentication by a Secret Token. All communication with the servers is done through the HTTPS communication protocol. In addition, for web applications authentication will be performed using a token (cookie) to avoid the CSRF (Cross Site Request Forgery) (Forgery of inter-site requests).

The system contemplates the control of inactivity times of sessions of up to 15 min, once this time has elapsed, users must authenticate on the platform again. The databases can only be accessed from the servers on which the applications and interfaces of the TeleAgro platform are installed.

The information stored in the application and database servers will be encrypted with unique 256-bit keys through the AES-256 encryption algorithm. The passwords will be stored in an encrypted way, with a mechanism for stretching passwords using the PBKDF2 algorithm with SHA256 hash.

5   Conclusions

Through the implementation of this platform it is possible to have a communications system that responds to the requirements of the livestock farmers of the department of Cesar in Colombia, since it manages to identify the different variables that begin in the processes of: fertilization, productivity and variable management to support decision making in this sector.

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