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Teleagro's Telecommunications Architecture - Georeferencing and Detection of Bovine Cattle Zeal

Ariza-Colpas Paola Patricia[a*], Pineres-Melo Marlon Alberto [b], Morales-Ortega Roberto Cesar[a], Collazos-Morales Carlos Andrés[c], Melendez-Pertuz Farid Alexander [a], Ovallos-Gazabon, David Alfredo[d], Cardena-Ruiz, Cesar Augusto[c] and Roca-Vides Margarita Beatriz[a]

[a]*Universidad de la Costa, CUC. Street. 58 # 55 - 66 Barranquilla – Colombia*
[a] *Universidad del Norte. Kilometer. 5 Via Puerto Colombia. Barranquilla – Colombia.*
[b]*Universidad Manuela Beltran. Career. 1 # 60 - 00 Bogotá – Colombia.*
[c]*Universidad Simón Bolívar. Street. 58 # 55-132.Barranquilla – Colombia.*

Abstract

The efficiency of a productive sector is measured at the regional level by the ability to fully supply the domestic market 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 technician bovine production sector, in some cases with the compensated basket, or subsidized production, with superior infrastructure and an exchange rate in their favor, therefore the technological lag in the department the possibility of accessing international markets would be increasingly remote. This article shows the design of the architecture of applied technology, in a sector of high relevance in Colombia.

Keywords: Technological system, Telecommunications Architecture, Bovine Cattle Zeal.

* Corresponding author. Tel.: +57 - 3002287498; Fax: +355 22 66 999
E-mail address: pariza1@cuc.edu.co

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1. Introduction

The use of different technologies has permeated the development of the cattle sector in worldwide, to solve problems related to the quality of products generated [1]. One of the technologies that has been used the most is the detection of cow's heat, which allows the identification of the animal's hormonal variability for different purposes [2]. Using technology in this context, a preponderant cost reduction can be achieved and small farmers can gain competitive capaity. This article shows the results of the implementation of the telecommunications architecture designed for the development of the Teleagro - Georeferencing System of bovine cattle heat applied in the department of Cesar in Colombia.

Fig. 1. Department of Cesar – Colombia.

The department of Cesar in Colombia has been characterized as an epicenter of bovine development in this country. Because the vast majority of the hectares of rural development are dedicated to this activity. That is why Fegacesar - Foundation of farmers of Cesar, served as an end customer for the pilot and implementation of the socialized project in this article [3].

One of the great problems that farmers have in the department of Cesar is the non-measurement of different variables related to bovine heat, which brings with it the need to have a bull permanently for the process of procreation in cows, as well as the waste of the animal's heat time to be able to perform the artificial insemination processes [4].

This article describes the communications architecture used for this purpose, in the development of the following sections. First, a brief review of the literature is carried out by comparing with existing solutions. Second, the architecture of the solution that was implemented is shown. Finally, the conclusions are detailed.

2. Brief Review of Similar solutions in the area

As a result of the systematic review of the literature, the following solutions similar to those implemented and described in the article can be detailed. AfiAct II [5], the devices are attached to the legs of cows to get an accurate measurement of the activity of walking / resting / being foot, every 15 minutes, which is programmable by the user of transmits, so wireless, updated activity data, through the the Reader towards the farm software herd management software. When the lector captures the information of the barn, send this data to the farm software [6]. The software manages and manages the data, which allows the farmer to show relevant and real-time information on the herd solution.

Another solution in the literature, is Celotor software [7], the application is composed of three indispensable parts. First, an injectable chip, which is in each of the respective cows. Second, a reading belt, in each of the bulls and third a master collar which is installed by lot, a collar every 40 cows. Every cow in heat is ridden by its companions or by the bull, the jumping cow or bull will have the reader belt on its chest and the cow that is allowed to ride will have the chip injected at the base of the tail[8]. During riding or standing an animal is above the one that is allowed to be mounted, so that the chest of the animal that is mounted is on the base of the tail of which it is allowed to mount and therefore the reader belt is on the injected chip. In this way the belt reads the identification of the cow in heat. This identification is sent wirelessly to the Master Necklace and this in turn originates alerts through real-time text messages. You can also view the information in emails and on a website.

Additionally, Traxco[9], it is a collar that, once placed on the neck of the animal, sends direct messages to the mobile phones of the owners indicating if the animal is sick or if the cows are ready to mate. The collar has a computer program that records during the first days the normal behavior of the animal. In this way, it is able to detect subsequent behaviors out of the ordinary. This collar incorporates an accelerometer, the same technological mechanism used in Wii consoles, which allows the detection of heat by detecting unusual movements of the head of the beef and also takes its body temperature, generating parameters that are immediately communicated to the Farmer with the sending of SMS, allowing the farmer to control the status of his cattle in real time [10]. Even being away from the farm, receiving such information on the mobile phone allows you to act on the same day and artificially mate or inseminate the animal in a timely manner, with guarantees of success.

3. The Telecomunications Architecture

This solution is composed of a set of devices of high importance for the capture and processing of data, which are detailed below:

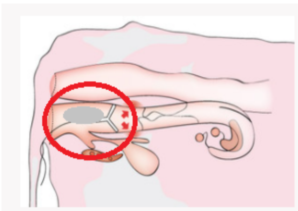

Fig. 2. Intravaginal Sensor

Intravaginal sensor: This device is located in the vagina of each of the cows, with the end of transmitting the data of the captured temperature to the main device [11].

Fig. 3. The main device

The main device: It is one of the most important devices because it stores and centralizes information from the pedometer, the temperature of the animal and also its positioning through GPS [12].

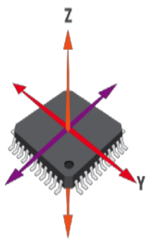

Fig.4. The pedometer

The pedometer: Through this device, the translation of kinetic energy into electrical energy can be performed, identifying the position of the animal and the number of steps it takes, as a fundamental variable to determine the heat in the cows [13].

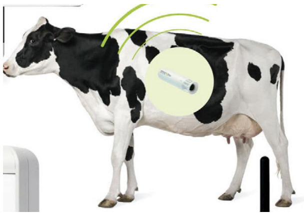

Fig. 5. The temperature Sensor

The temperature sensor: This sensor allows the transformation of thermal energy into electrical energy, allowing to send to the main device, this data of high relevance for the process of artificial insemination of the cow [14].

The RF Module, this module is responsible for carrying out the communication between the proposed architecture and the LoRa commands, necessary for the analysis of the situation of the herd of animals [15].

The solution works in the frequency of 900MHz in the range of 902-928MHz, which has a range up to 15km without line of sight, see figures 6 and 7.

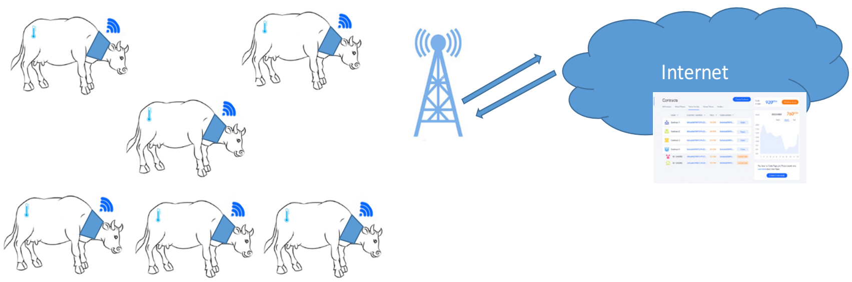

Fig. 6. General Topology

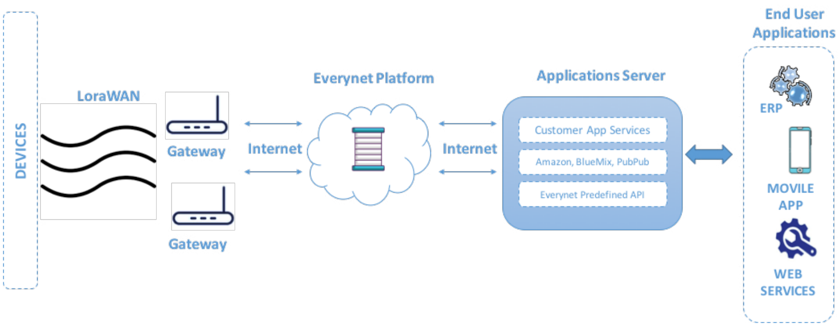

Fig. 7 Communication Architecture

The characteristics of the communication architecture is shown below:

LoRaWAN Network Server: LoRaWAN high performance network server distributed geographically in the cloud.

Gateway Management: Monitor and manage all gateways. Fast diagnosis of potential problems and detailed statistics display.

Coverage Management: The customer can check the coverage quality of their everynet network from anywhere in the world and analyze the coverage quality of their network section.

Device Management: Device registration, monitoring and maintenance. Device security configuration with a unique id across the entire everynet platform. Development and debugging support.

Statistics: Extended statistics of devices and gateways.

Integrations available: The everynet platform is ready to connect to PubNub, Amazon IoT, IBM Bluemix. The Platform also supports pre-defined APIs for Electric / Water / Gas and Tracking meters.The everynet platform - that is a distributed platform in the cloud allowing you to connect and manage LoRaWAN ™ compatible gateways that are anywhere in the world and transmit data from end devices to end user applications.

• The platform has a web interface for network management.

• The client can monitor and manage both their network and their devices through their own platform instance.

The LoRa Network Gateway is a very compact network base station and fully compatible with LoRaWAN ™. It was designed to offer low cost, simple installation and manage the LoRaWAN ™ network infrastructure [16]. With integrated GPS and 3G antennas, a main PoE source with an integrated backup battery; with flexibility and redundancy capacity. The LoRaWAN ™ Network Controller and all management and monitoring is provided by the everynet platform and is included.Both devices will work in front of the server, that is, they will each send their data independently and autonomously [17].

The main device located in the cow harness will send the following variables: Steps in the last 15 minutes, Alert steps in the last 15 minutes by discharge, Steps in the last 60 minutes, Alert steps in the last 60 minutes by discharge, Head tilted alert too long, Geocerca exit alert, Battery level, Low battery level alert, GPS location. Variables sent by the intravaginal device: Battery level, Low battery level alert, Temperature, High temperature alert, Low temperature alert.

Table 1. Table of variables by device

Variables	Main Device	Intravaginal Device
Temperature	X	-
P15	-	X
P60	-	X
Head Tilt	-	X
GPS location	-	X
Geocerca	-	X
Battery Level	X	X

4. Conclusions

As a result of this project, a hardware and software platform were obtained, aimed at detecting heat and preventing bovine cattle abuse. The hardware installed in each animal had at least one global positioning device, a pedometer (accelerometer) and a wireless communications system. The project contemplated the detection of bovine heat without the intervention of a riding bull from the measurement of the animal's behavioral variables. The georeferencing of the animals was carried out on a digital map and will allow real-time identification of the animal's exit from the assigned virtual area.

The detection of heat was carried out from the study of the behavior characteristics of the cows (walks, standing time, resting time) because it is well determined that a cow in heat has a very different behavior from a cow that does not It is in a fertile state. Motion sensors were used to determine if an animal is sick based on its behavior. The platform became a key system in the raising of cattle to the extent that it allows to increase the productivity of the animals, improves the ability to detect diseases and prevents the lack of.

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