.

UNIVERSIDAD TÉCNICA DEL NORTE

FACULTAD DE INGENIERÍA EN CIENCIAS APLICADAS

CARRERA DE INGENIERÍA EN SISTEMAS COMPUTACIONALES

GRADE WORK PRIOR TO OBTAINING THE TITLE OF ENGINEERING IN COMPUTER SYSTEMS

SCIENTIFIC ARTICLE

THEME:

"Sistema tecnológico para la reducción de consumo de energía eléctrica en Yachay EP., mediante un equipo Raspberry"

AUTHOR:

Jenny Elizabeth Rea Peñafiel

TUTOR:

Ing. Diego Javier Trejo España

Ibarra - Ecuador
2015

.

SISTEMA TECNOLÓGICO PARA LA REDUCCIÓN DE CONSUMO DE ENERGÍA ELÉCTRICA EN YACHAY EP., MEDIANTE UN EQUIPO RASPBERRY

Jenny Elizabeth REA PEÑAFIEL
Carrera de Ingeniería en Sistemas Computacionales, Universidad Técnica del Norte, Av.17 de Julio 5-21 y Gral. José María Córdova, Ibarra, Imbabura, Ecuador

e-mail: jereap@utn.edu.ec

RESUMEN: *Tras la falta de un equipo que permita ahorrar energía eléctrica en la Empresa Pública Yachay, nace la idea de implementar el presente sistema. El proyecto consta de dos módulos: el módulo de control de dispositivos que, por medio de una Aplicación Web principalmente se pueda crear actividades de encendido y apagado de un dispositivo (depende del equipo) y el módulo de conexión de dispositivos que, por medio de un equipo Raspberry Pi y un circuito armado se permita el paso u obstrucción de flujo de corriente eléctrica; logrando de esa forma reducir el consumo de energía eléctrica. Es importante mencionar que para generar un sistema de calidad se ha aplicado una metodología estricta como es RUP.*

PALABRAS CLAVE: Consumo de energía eléctrica, Metodología RUP, Raspberry PI, Sistema escalable, Software libre.

ABSTRACT: *After the lack of the equipment that allows save electricity in the Yachay Public Company, it begins the idea to implement this system. The project has two modules: the control module devices that, through a Web Application can be created mainly activities on and off a device (depending on equipment) and the connection module devices that, through of Raspberry PI and assembly circuit, it is allowed the pass or obstruction of flow of electric current; getting in this way to reduce the electricity consumption. It is important to mention that to create a quality system is necessary to apply a strict methodology like as RUP.*

KEY WORDS: Electricity consumption, Open source, RUP Methodology, Raspberry PI, Scalable system.

1 INTRODUCTION

The Yachay Public Company is an organization created in able to support to “Ciudad del Conocimiento Yachay” project, which has like main goal to make technology investigation to get a better production of the Matriz Productiva in our country. The Support Department and Technological Operations, it has all the possibilities to guaranty innovations systems with the porpoise to help to the environment; that is why, have been developed this modules.

Today, in those offices, the regulations on and off of electric devices control are not maintained so, they haven´t the enough automation; that is why different problems are presented. It is possible to name the following: difficulty to elaborate the budget in the empress expenses, decrease in the lifespan of devices, and so forth. These problems have the responsible persons in the company because it is more difficult to manage of devices.

Thanks to the technological evolution, empresses have been able to build and trade electronic devices, so they can quality signs; that they let give solutions to the mentioned problems. This degree project will grow by better way the electric energy wear in the administrative offices in the Support Department and Technological Operations (SOT's) from Yachay EP.

.

2 MATERIALS Y MÉTHODS

2.1 Software and Hardware used

2.1.1 Software

To implement the two both system modules the following tools were applied:

In the web application is used the technology: Java, JSF and PrimeFaces like frameworks (Eclipse IDE). In the desktop application of the Timer, it is used of Java and y the Timer library (Netbeans IDE); according with the devices module control. Besides the server where the applications run is named Apache Tomcat; keeping and reading their data in PostgreSql database.

The devices module connection has a server in the Raspberry PI; it is implemented in the Python language.

2.1.2 Hardware

- The control module has:
  - 1 Fedora server

- The devices module connection consists of:

  - 1 Raspberry PI (B model)
  - 1 electronic circuit (to operate two devices) is formed by:

    - 2 relays of 5 to 110V
    - 2 resistors of 1K
    - 2 silicon diodes 1n4007
    - 2 transistors 2n3904
    - 4 borneras
    - 1 bakelite de 7 x 6 cm.

2.2 RUP Methodology

To develop quality system it is necessary to apply a software engineer methodology; in this case Rational Unified Process (RUP) Methodology is applied. This methodology has four phases: Begin, Elaboration, Construction y Transition.

Inception.- in this phases to verify the project feasibility a list with possible risks is generated and the Vision document which presents the current empress situation (the problem) and the users (stakeholders).

Elaboration.- after the analysis of the empress trouble, a list of requirements is generated which must be implemented in the system; besides the software architecture document is created, it contains: the use cases, the diagram company relation of date base and the data dictionary.

Construction.- after the database designed and the cases of use, the next step is to specify detailed, the use cases mentioned in the before step, to program and build the same ones and realize the proofs to the system.

Transition.- at the end, the project is finished and ready to be used. In the document is showed in the deploy diagram of system. Besides, the staff is prepared in the empress for its manage and the user manual and technical are provided.

3 RESULTS

It is important to recognize that the results were very satisfactory, getting to generate scalable system and implementing with open source. The Yachay EP company, will can add more equipment to the system to save electric energy and this way to collaborate keeping the environment and to reduce the economic cost too (pay the voucher electric and buying new equipments).

It was mentioned the project contains two modules:

- Devices module connection: to connect the devices (Smart TV, lamp) to the control circuit of electric flow to Raspberry Pi, in able to be handle, so it lets flux of electric current.

  - In the Raspberry is Python server, which send the on and off data to the GPIO; the same ones are sent by the control module server of devices control.
  - The GPIO del Raspberry Pi is connected to the circuit in able to control the pass of electric energy with a relay; it is at the same time connected to light extensions where the circuits are going to be connected.

.

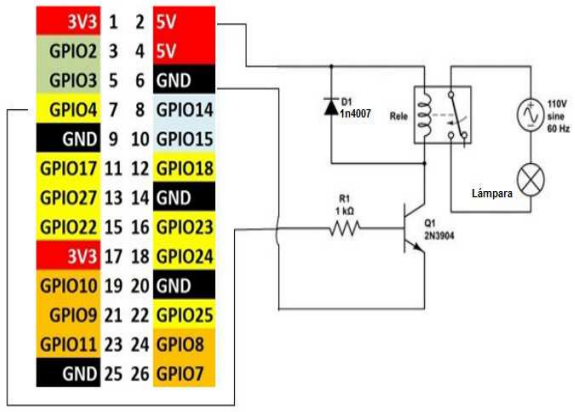

Illustration 1 Control circuit of electric flow diagram.

- The Web application let to manage: functionaries, models, raspberries, devices, kind of devices and parameters; so it generates the CRUD of corresponded elements.
- It allows visualize the auditory events.
- It generates activities in able to on or off a select device (pass of electric current flow) and to make that, it uses the desk program: Timer.
- It shows the electric consume by the connected devices to the circuit.

- Devices module control: To manage the main elements (functionaries, raspberries, devices, activities and so forth) in order that the system works in a better way according with the graphic interface in the application that int will be consume by the browser and the desk program Timer.

In able to have better idea of the system, then it shows a illustration of the System Architecture (Illustration 2).

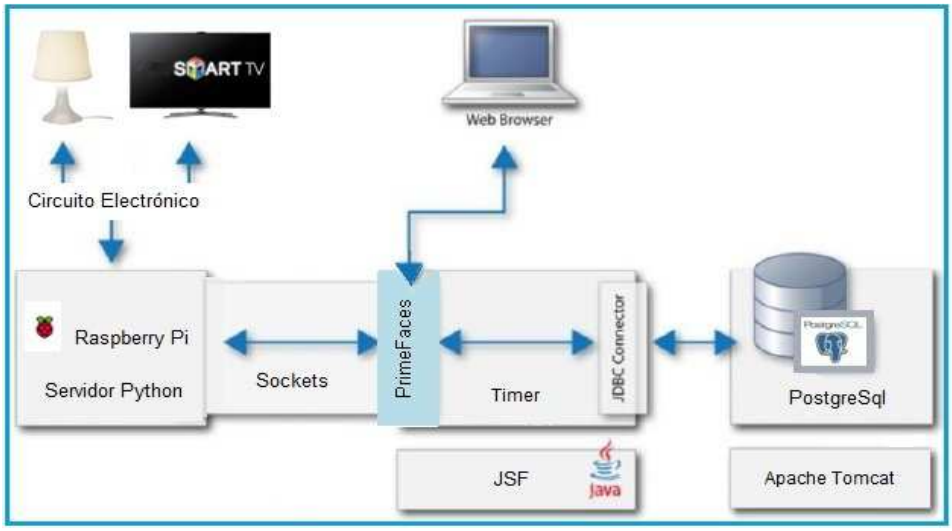

Illustration 2 System Architecture.

.

Entity – Relationship Model (ER Model)

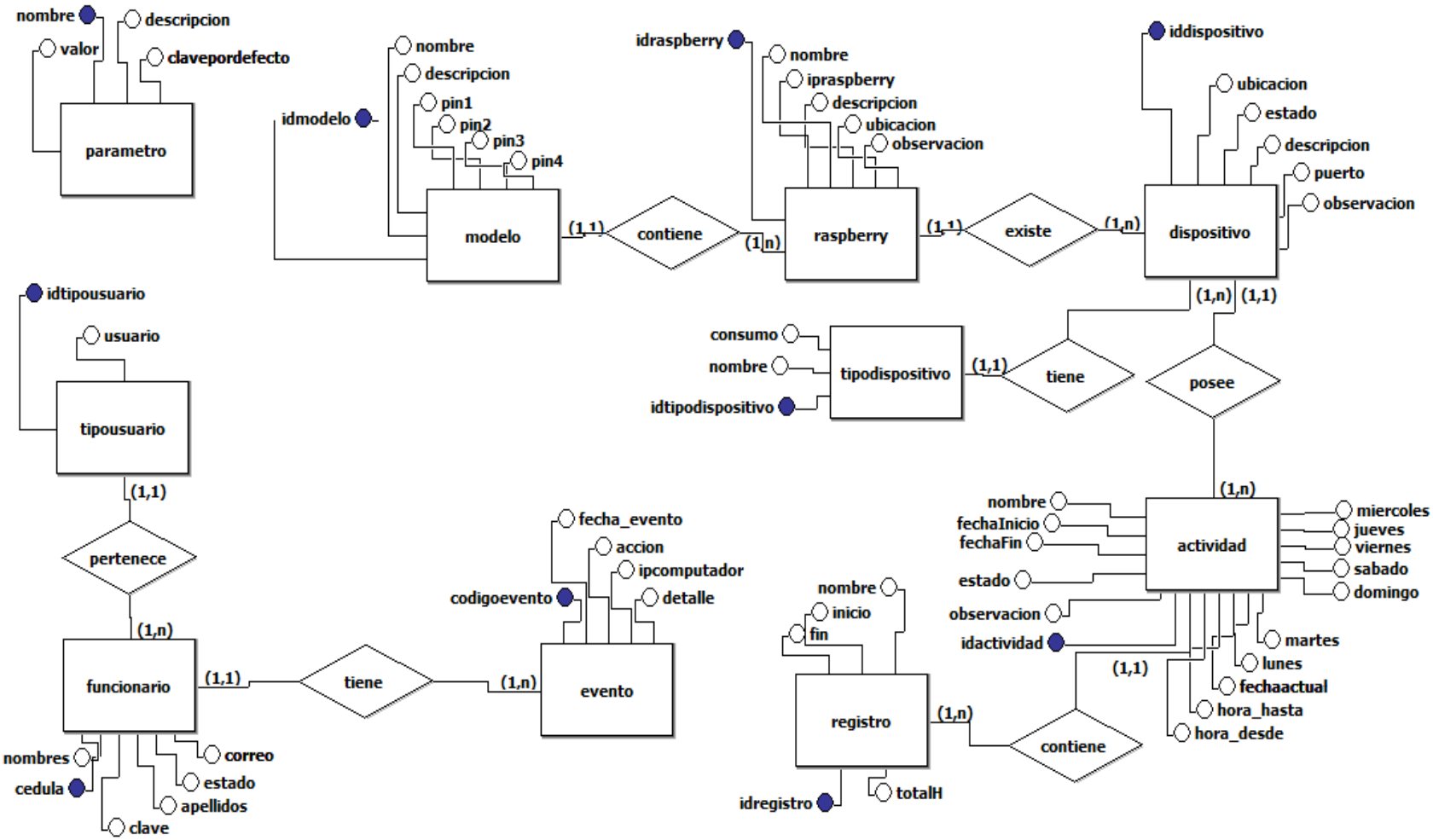

Illustration 3 Entity-Relationship Model of Web Application.

.

4 CONCLUSIONS

Finished this work, it is possible to define the following conclusions:

- The absence of electronic devices for an electric consume control into the San Eloy farm offices, it makes that the empress present some big consumers when there are no necessary energetic consumes.
- The Raspberry Pi has the advantage of been started during the 24 hours at day during all the year, because it hasn't components that can get over warm, so it would have a high resource and it would be out of function in cases of electric energy suspension into the empress offices or for maintenance of it.
- The Xerox X8900S printer does not take part of the devices to consume the application because for its special off it can get damages and it represent costs to the empress.
- When a development methodology is used, in this case RUP, it is possible to guarantee that the system complies with many quality requirements.
- To add a server of central applications it allows to implement a scalable system where can be connected a major quantity of raspberries device and electronics or electric ones.
- The creation of the timer in a desk program, it allows to the system that controls the pas or cut of electric energy flow to stay active in case of stop of Apache Tomcat server.
- The PrimeFaces framework allows to accelerates well considerable the development of web application.

AGRADECIMIENTOS

A sincere thanks to the Support Department and Technological Operations from Yachay EP., for all its aid, facilities gives to realize this project; its well advices let me complete this goal.

To Ing. Paúl Vásquez, Analyst of SOT's Department from Yachay EP., for your friendship, collaboration and guide in this work.

A special thanks to the **Ing. Diego Trejo, Thesis Director,** fundamental guide in the elaboration of this project.

To my partners GRICELDA Y SALVADOR for give me a lot of love and unconditional helping in my education, both academic and life. To my brothers MAURI Y ROLY, in reason of you are staying always near to me helping in everything; like guides and advice me your knowledge.

To Franklin Vaca, Yachay practitioner, for your help in this important phase, collaborating always and giving me encouragement to finish this goal.

To the UTN for the opportunity to know so well professors and friends.

REFERENCES

[1] Apache Tomcat - Welcome! (s. f.). Recuperado 15 de julio de 2015, a partir de http://tomcat.apache.org/

[2] Consulta de Consumos. (s. f.). Recuperado 1 de mayo de 2015, a partir de http://www.emelnorte.com/eern/index2.php?option=com_wrapper&view=wrapper&Itemid=86

[3] Consultas de Consumo - EMELNORTE S.A. (s. f.). Recuperado 1 de mayo de 2015, a partir de http://www2.emelnorte.com/consultas/consumos/con_sumi.php

[4] DellTM XPSTM 8500 - Manual del propietario. (s. f.). Recuperado 12 de febrero de 2015, a partir de http://downloads.dell.com/Manuals/all-products/esuprt_desktop/esuprt_xps_desktop/xps-8500_Owner%27s%20Manual_es-mx.pdf

[5] Derby Developer's Guide. (s. f.). Recuperado 12 de febrero de 2015, a partir de http://db.apache.org/derby/docs/10.11/devguide/index.html

[6] HP Pavilon dv7 Notebook PC - Maintenance and Service Guide. (s. f.). Recuperado 12 de febrero de 2015, a partir de http://www.hp.com/ctg/Manual/c02842278.pdf

[7] HyperSQL User Guide. (s. f.). Recuperado 12 de febrero de 2015, a partir de http://hsqldb.org/doc/2.0/guide/index.html

[8] Java Platform Standard Edition 7 Documentation. (s. f.). Recuperado 15 de julio de 2015, a partir de http://docs.oracle.com/javase/7/docs/

[9] Lámparas de Mesa. (s. f.). Recuperado 12 de febrero de 2015, a partir de http://merchandisingservices.net/files/Presentacion-Lamparas-de-Mesa.pdf

.

[10] LG 55LA6600 | LG Electronics EC. (s. f.). Recuperado 4 de mayo de 2015, a partir de http://www.lg.com/ec/televisores/lg-55LA6600
[11] López Guillén, Elena, B. M. Ignacio. (2009). Fundamentos de electrónica (2a.ed.). Servicio de Publicaciones. Universidad de Alcalá.
[12] piface_digital. (s. f.). Recuperado 11 de febrero de 2015, a partir de http://www.piface.org.uk/products/piface_digital/
[13] PrimeFaces. (s. f.). Recuperado 15 de julio de 2015, a partir de http://www.primefaces.org/whyprimefaces
[14] que-es-raspberry-pi. (s. f.). Recuperado 11 de febrero de 2015, a partir de http://www.raspberryshop.es/que-es-raspberry-pi.php
[15] Sobre PostgreSQL | www.postgresql.org.es. (s. f.). Recuperado 15 de julio de 2015, a partir de http://www.postgresql.org.es/sobre_postgresql
[16] What is a Raspberry Pi? | Raspberry Pi. (s. f.). Recuperado 11 de febrero de 2015, a partir de http://www.raspberrypi.org/help/what-is-a-raspberry-pi/
[17] Xerox ColorQube 8900 Color Multifuntion Printer-Detaileid
Specifications. (s. f.). Recuperado 11 de febrero de 2015, a partir de http://www.office.xerox.com/latest/890SS-01U.PDF

Sobre la Autora.

Jenny Elizabeth REA PEÑAFIEL.- I was born on march 16th 1993, in El Jordán district of the Otavalo city. My partners: Salvador Rea Toapanta y María Gricelda Peñafiel.
My primary instruction realized at: Francisco Moncayo school in Otavalo city and Pedro Moncayo school in Ibarra city, then I studied in the Nacional Ibarra High School of the same one, where I obtained the bachelor's degree in mathematical physicist. I began to study at the Técnica del Norte University in able to obtained the Computer Systems Engineering degree.