

INTERNAL COMMUNICATION SYSTEM USING GPRS/GSM AND RASPBERRY PI

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RESUMEN

Actualmente la mayoría de las personas utilizan un celular o dispositivo inteligente para organizar sus actividades diarias. Estas Tecnologías de la Información y la Comunicación (TICs) son útiles en organizaciones. Particularmente el envío de Mensajes Cortos de Texto (SMS) con el fin de cumplir con procesos administrativos. En los Institutos Tecnológicos es uno de los más importantes en el proceso de titulación.

Para realizar una aplicación con esa capacidad se utilizó el hardware Raspberry Pi 3B+ y modem GSM; los softwares Raspbian, Gammu, Apache, Sybase/MYSQL/MariaDB y PHP.

Se desarrolló una aplicación que envía mensajes de texto directo al celular con un tiempo de ejecución corto, de envío y llegada. Esto para mejorar la asistencia de los sinodales, mediante un recordatorio vía un mensaje un día antes del evento programado de titulación. Se ha registrado una disminución en el ausentismo del evento del 23%, respecto a cuando no se utilizaba SMS.

Palabras Clave: SMS, GSM, Raspberry Pi.

ABSTRACT

Currently most people use a cell phone or smart device to organize their daily activities. These Information and Communication Technologies (ICTs) are useful to organizations. Particularly the sending of SMS (Short Text Services) messages in order to comply with administrative processes. In the Institutes of Technology is one of the most important in the final alumni qualification process.

To make an application with this capacity, the Raspberry Pi 3B+ and GSM modem hardware are used; together with the software Raspbian, Gammu, Apache, Sybase/MYSQL/MariaDB and PHP.

An application was developed that sends direct text messages to the cell phone with a short execution time, for sending and receiving. This to improve the attendance of the synods, by means of the reminder via the message one day before the scheduled event. There has been a decrease in the absenteeism of the event of 23%, compared to when the SMS was not used.

Keywords: SMS, GSM, Raspberry Pi.

1. INTRODUCTION

In any organization, one of the main activities is to offer a quality product/service. To achieve this, staff must be well informed about the general, administrative and technical processes of the organization. Organizational communication is integrated into the process of issuing and receiving messages from an organization, which has as its main objective the knowledge of all its members to be informed of the subsystems and variables

that make up the administrative process and more importantly, the changes that arise in the organization.

In today's times, information and communication technologies have taken a significant place in the communication processes that take place in organizations, as most people have smart devices and continuously accessing them seeking to establish communication with other people and/or update in different aspects, these are commonly news related to the different variables that integrate their work or personal life.

This project looks for the development of a system that automates internal communication in organizations, mainly seeking to improve the productivity of workers, by generating mass sending of short text messages, called SMS; efforts of this kind have been made in various activities such as: blood bank services [1], access to bitcoin wallets [2], field data acquisition [3], optimization of communication between students of a particular career [4], industrial applications [5], in fact there are some software on the market that allow to carry out this activity but with high costs of licensing and/or high monthly rents for its use. As one of the main objectives of this work is to develop a system that can be very accessible both economically and technically for all types of organization.

This research seeks to determine whether a free software platform, under Linux, improves communication processes adapted to the needs of the organization at a low cost. Taking advantage of the fact that most people use a mobile phone or smart device to organize their daily activities, these contain reduced rates offered by cell phone companies, including unlimited calls and text messages.

In the development is sought to use PHP, which is an open source software that serves for the management of email lists, it was specially designed for the dissemination of information of all kinds to a specific list of subscribers, also uses a MySQL database to store the information. The management of records-subscriptions, personal data, and lows is automatic [6], on the other hand, the Raspberry Pi, considered to be a computer the size of a credit card, but at a much lower cost than a full computer, as well as with a weight of no more than 50 grams,

has a processor that typically operates at a frequency of 700 MHz, an SD card slot that has the function of installing a bootable operating system such as: Raspbian, Pandora, Raspbmc, etc. In addition, 4 USB2.0 ports to connect devices such as keyboard, mouse, etc. [4], being all the above-mentioned features important for the realization of this project as they meet the expectations that are being sought.

Related to this, an application was developed with information and communication technology through Raspberry Pi 3B+ and a GSM modem that carries out the sending of short text messages (SMS), thus automating the qualification process in the TecNM/Cuauhtémoc City Institute of Technology.

It is also important to mention that there are a lot of authors who talk about the development of systems using Raspberry Pi which provides important help to facilitate the progress of the project, such as Khedkar & Malwatkar, they use it for the generation of a system for smart homes [7], Vickey and other collaborators used it to develop a smart news board [8], Patchava Vamsikrishna, et.al in their article "SMS-Update-Notification System (SUN) controlled by Raspberry PI" introduce the development of a short message system for reporting updates to people within a work environment [9], Muddu and Nagaraju used the Raspberry to develop and implement a message system short for a Blood Bank [5]; the above examples are just a small sample of all the possible developments with this platform.

2. RASP IMPLEMENTATION

Raspbian, Apache, Sybase/MYSQL/MariaDB, PHP by its acronym in English RASP, it is a free software platform that integrates an Operating System, a Database handler, a WEB server, and a Programming Language, which allows the development of applications, as the one described in this work.

2.1 Methodology

One of the essential activities in the organizations is their internal communication, for this reason it is important to realize it in an effective way, for which the use of the new communication technologies is of great support to this activity, it is sought to achieve it through the configuration of a Raspberry Pi connected to a GSM/GPRS card and establishing connection to the database of the Integral Information System (SII) [10]. SMS messages will be sent to the professors who participate in the certification process of the Institutes of Technology; informing each one, the time, place and date of their participation in the final alumni qualification. Since the SII is a system that contains information from the entire institution, we will only think about accessing tables that have data from this process with restricted SQL queries.

2.2 Equipment

For this project the single-board computer (SBC) Raspberry PI 3B+ was used with the following features [11]:

Processor CPU + GPU: Broadcom BCM2837B0, Cortex-A53 (ARMv8) 64-bit SoC @ 1.4GHz.
 RAM. 1GB LPDDR2 SDRAM.
 Network Card. Wi-Fi + Bluetooth: 2.4 GHz y 5 GHz IEEE 802.11.b/g/n/ac, Bluetooth 4.2, BLE Ethernet: Gigabit Ethernet on USB 2.0 (300 Mbps).
 Hard Drive. MicroSD 16 GB.
 The Operating System distribution is Raspbian 9 stretch [2].
 Figure 1 displays the Raspberry PI 3B+.



Figure 1. Raspberry PI 3B+.

2.3 Database

The query of the information is made in the Database used by the SII, which is designed in the Database Management System SYBASE in its version 15.02, when installing the RASP platform in the Raspberry PI, by default the MySQL/MariaDB is loaded, so we proceeded to install a PHP library to connect to the SII Database. Table 1 shows a comparison of Database handlers [12].

Table 1. SGBD comparative.

SGDB	FEATURES	ADVANTAGES	DISADVANTAGES
MYSQL	Broad language subset SQL. Multiplatform Motor of bd open code Is Open Source.	Stability No licenses	A large percentage of their utilities are not documented.
SYBASE	Security as authentication for users on servers. Is Open Source and owner	Most used in Linux. Ease of use Secure Configuration.	Not suitable for online transactions. Programming limitations

The installation of the *sybase-ct* library was carried out in the following manner [13]:

```
sudo apt-get install php-sybase
dpkg -L php7.0-sybase
```

2.4 Connectivity

To accomplish the obtention of information required for sending messages, the connection to an external server database is required, which works with the SYBASE database engine version 15.0.2 for Linux [6].

The required information is distributed in two tables as is described into the UML diagram of Figure 2.

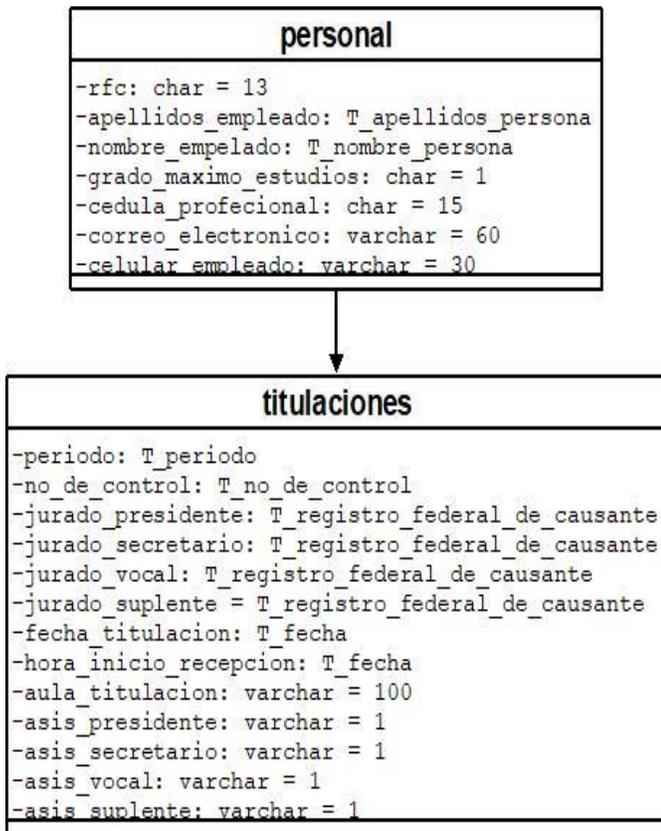


Figure 2. UML Diagram.

The related fields in the Qualifications table, *Jurado_presidente*, *Jurado_secretario*, *Jurado_vocal*, *Jurado_suplente* will be the corresponding RFC data from the *Staff* table, where the phone number field is used, this way, you can determine the assigned date and time using this information for the development of each of the messages that will be send.

2.5 Send settings

Already having installed the *Sybase* library in PHP, a script was created in the same language to prove that there was connection with the database server. The algorithm described in Figure 3

oversees testing the database connection before sending messages.

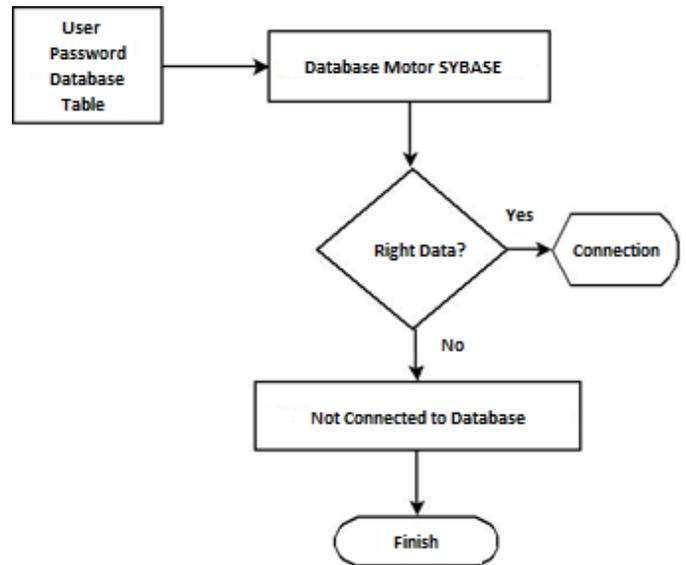


Figure 3. Testing connection algorithm.

A cron was set up to run in the background the script that sends SMS messages to all professors involved in the titling process. The program is executed every day at 18:00 hours, with the purpose of them receiving the information about the professional reception they will have the next day. The cron was specified as:

```
00 18 * * * pi php /var/www/html/titulacion_bd.php
```

The execution of this Script does not interfere with the other functions of the Raspberry PI, in the same way, the connection to the database is secure, because only information related with the process of titling is consulted.

3. GPRS/GSM CONNECTION

GPRS Technology (General Packet Radio Services) is based on the switching of packets over the GSM cellular telephony network. This technology allows the GSM data to be compatible with the WAN and LAN networks using the TCP/IP protocol. It allows to transport different messages by the same medium and different destination without having a dedicated channel and uses the GSM network only when there are data to send or receive. This efficient use of the network makes it an ideal technology for data applications [7].

For the benefits it offers, the GSM network is widely used in the development of projects requiring data transmission. In the environmental and agricultural sector, in enterprises, public or private educational institutions [1].

To achieve GPRS/GSM connection in the Raspberry PI the GSM ADD-ON v 2.3 card with a SIM 800 chip was used [5]. The card used is shown in Figure 4.



Figure 4. GSM ADD-ON v2.3. card

Table 2 shows the pins map of the GSM ADD-ON card for the Raspberry PI connection.

Table 2. Pins map 1-13 GSM ADD-ON with Raspberry.

Raspberry PI Pin N.O.	Pin name	Description
1	3.3V	
2	5V	
3	GPIO02	SDA
4	5V	
5	GPIO03	SCL
6	GND	
7	GPIO04	
8	GPIO14	GSM_DIN
9	GND	
10	GPIO15	GSM_DOUT
11	GPIO17	SIM800-PWRKEY
12	GPIO18	SIM800-RST
13	GPIO27	
14	GND	
15	GPIO22	
16	GPIO23	
17	3.3V	
18	GPIO24	
19	GPIO10	SPI_MCSI
20	GND	
21	GPIO09	SPI_MISO
22	GPIO25	
23	GPIO11	SPI_SCK
24	GPIO08	SPI_CEO
25	GND	
26	GPIO07	SPI_CEL

In Figure 5 the resulting connection between the Raspberry PI 3B+ and the GSM ADD-ON v2.3. card is shown.



Figure 5. Raspberry PI with GSM ADD-ON.

3.1 GAMMU-RPI

There are different free software tools that allow connection and communication with the computer via USB port, Bluetooth, GSM/cards. The most recommended to establish communication and allows the development of scripts for use, is GAMMU [14]. Figure 6 shows the result of executing the command.

`gammu --identify`

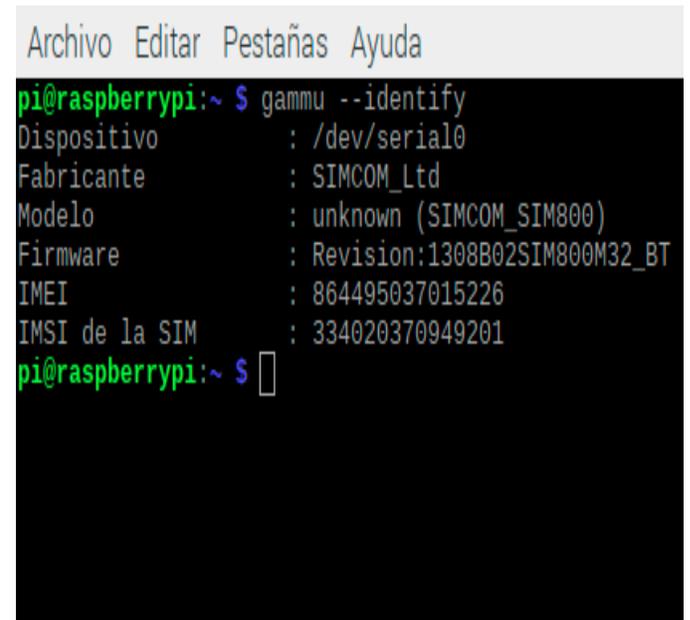


Figure 6. Gammu.command.

3.2 Sending messages

To configure the sending of SMS messages, a PHP script was developed to connect to the database and send the messages to the professors participating in the qualification process as Jury: President, Secretary, Vocal and Alternate; results were as follows.

```
<?php
require_once("config.inc.php");
require_once("funcion_sql.php");
$fm=strtotime($fecha);
$fr=date("d-M-Y",$fm);
$aula=$lista->fields('aula_titulacion');
$hora=$lista->fields('hora');
$men="\nLe informamos que el DIA:'. $fr.' a la hora '.$hora.' ud
tiene una TITULACION en '.$aula.'. Mensaje automático, no
es necesario responder\n";
$men2="\nLe informamos que los mensajes del DIA:'. $fr.'
fueron enviados\n";
$mensaje='echo '$men.' | gammu sendsms TEXT
'.$presidente;
$division='celular_DEP';
$cc='celular_CC';
$sms=exec("$mensaje");
$mensaje='echo '$men.' | gammu sendsms TEXT '$secretario;
$sms=exec("$mensaje");
$mensaje='echo '$men.' | gammu sendsms TEXT '$vocal;
$sms=exec("$mensaje");
$mensaje='echo '$men.' | gammu sendsms TEXT '$suplente;
$sms=exec("$mensaje");
$mensaje='echo '$men2.' | gammu sendsms TEXT '$division;
$sms=exec("$mensaje");
$mensaje='echo '$men2.' | gammu sendsms TEXT '$cc;
$sms=exec("$mensaje");
?>
```

Similarly, an SMS is sent to the titling process holder and the system development staff to indicate that the messages were sent.

4. RESULTS

Tests for sending messages with two different instructions were conducted: Gammu_sms and Gammu_smsd-inject having the results in executions times shown in Figure 7.

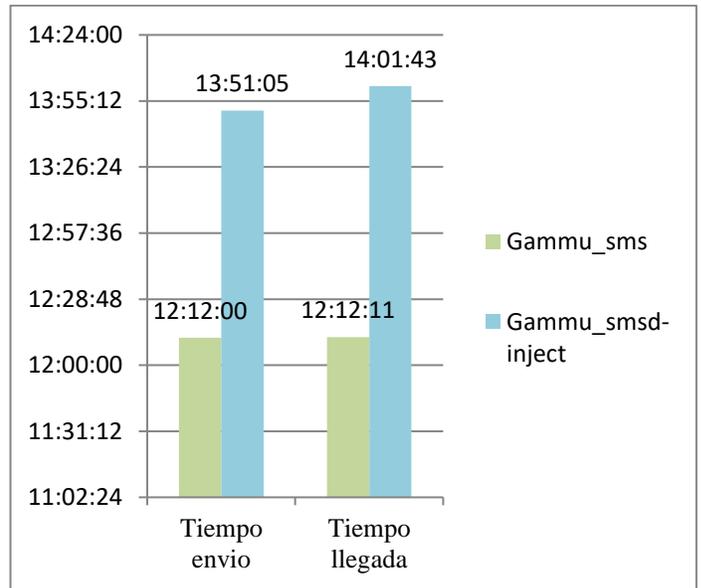


Figure 7. Execution times graph.

Making the comparison of the year 2017 where 397 alumni of the different specialties were titled in the Institute of Technology of Cuauhtémoc City, where 4 synods are allocated for each one of them, making a total of 1588 invitations, there was a 30% absenteeism, meaning that 476 synods did not attend the event. In 2018 the alumni titled were 458, for a total of 1904 synods assignee, having 133 synods not attending, being this 7% absenteeism, as shown in Figure 8.

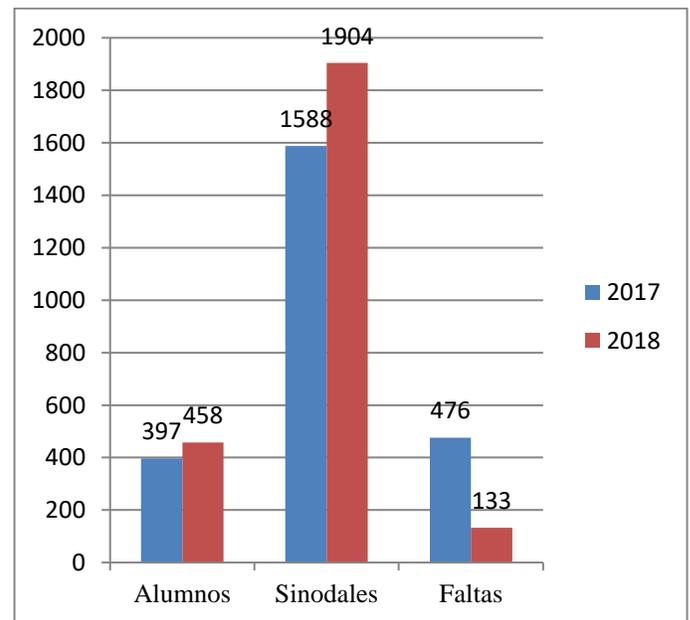


Figure 8. Synods attending graph.

Figure 9 shows the result of the SMS message sent to the Synodal one day before its participation.



Figure 9. SMS for Titling process

Figure 10 represents the result of the SMS sent to the titling process manager.

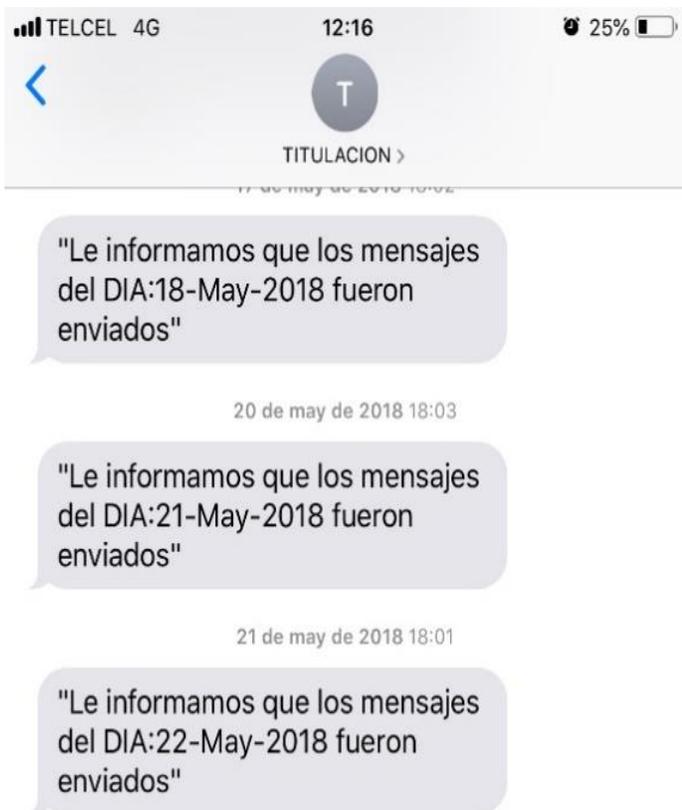


Figure 10. SMS Sent.

5. CONCLUSIONS

It was determined the use of Gammu_SMS as a shipping instruction for its shortest execution time, both shipping and arrival. As for the attendance of the synods by the reminder via message one day before the scheduled qualification event, 7% of absenteeism is recorded, meaning a decreasing of 23% in comparison of the previous year where the tool is not used. Absenteeism of the year 2018 is reported to be because of other variants beyond the lack of information on the scheduled qualification event

Acknowledgement

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