SISTEMA DE TRANSMISIÓN DE DATOS TOPOGRAFICOS DESDE UN COLECTOR TOPOGRAFICO A LA ESTACIÓN BASE UTILIZANDO LA RED DE TELEFONIA CELULAR

TOPOGRAPHICAL DATA TRANSMISSION SYSTEM SINCE A TOPOGRAPHIC MANIFOLDTO A BASE STATION USING CELLULAR NETWORK

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Resumen

En este trabajo se desarrolla un sistema de comunicación que tiene como funcionalidad transmitir la información recolectada por un colector topográfico, que por lo general se encuentra ubicado a una distancia de varios kilómetros del campamento base, en el cual se recolecta la información de todos los colectores de la zona. La implementación de este dispositivo tiene como objetivo reducir los tiempos de recolección de datos y su procesamiento. La herramienta utilizada para él envió de esta información son los mensajes de texto (SMS) de un teléfono celular, aprovechando la cobertura de la red de telefonía celular. Para ello se diseñó una tarjeta de comunicación como interface entre el colector y el celular, la cual toma la información que suministra el colector en texto plano y se encarga de cambiarla de formato para que pueda ser capturada por el celular y ser enviada vía mensajes de texto al celular receptor que se encuentra ubicado en la estación base al computador encargado de recolectar la información total de la zona.

Palabras clave: Mensajes de Texto, Recepción, Tarjeta de Comunicación, Transmisión.

Abstract

It developed a communication system that has the functionality to transmit the information collected by a topographic manifold which is usually located at a distance of several kilometers from the base camp, in which information of all manifolds of the area was collect to be processed and stored for later analysis. The implementation of this device aims to reduce the time of data collection and the time for processing them. The tool used for this information is sent via text messages (SMS) from a cell phone taking advantage of the coverage of

the cellular network that is implemented in the country. The process begins with data collection by the topographic manifold which is acquired by a communication card that was designed as an interface between the manifold and the cell, which takes the information provided by the manifold in plain text and is responsible to change the format so it can be captured by the cell and be sent via text messages to the cellular receptor that is located in the base station to the computer responsible for collecting the total information in the area.

Key words: Card Communications, Broadcasting, Text Messages, Reception.

Introduction

In most companies engaged in seismic activity or exploitation of soils for oil, groups of surveyors are handled, which make data collection in the open field by instruments called manifolds, these devices collect information as coordinates to determine where one can find oil wells. The data collected are stored in the memory of the manifold, and at the end of the workday can come to camp and perform the download to the computer base station, this leads to not being able to know if any mistake was made in the path coordinates that are projected to take during the day, which means that only at the end of the workday can be verified data and committed errors that can only be solved until the next day, because of this you can get to delay the timetable projected can be delayed.

Because of this problem, it was designed the device described in this article, by which is intended to reduce the time for obtaining and verifying data, sending the information through text messages. In a literature review was established following: In the research "Construction and simulation of a model of integration of transmission networks based on SMDS data" [1] develop a prototype network Switched Service Data Transmission Multimegabit, taking into account the standard IEEE802.6, reaching to cover an area of 160 km, and to handle input and output channels with speeds from 4 to 34 Mbps, which it allows a connection to sub FFDI networks (fiber distributed data interface), also supports packages that have lengths of up to 9188 bytes, and multicast addresses.

Data transmission has many approaches or applications, research developed by Erazo Hernández and Carlos Enrique [2], a sending data is done through a network in a tank remote water to solutions that must be continuously surveyed, by a data converter from analog to digital and is also displayed, this RF transmission is by establishing a connection over a LAN and thus have a process of the water fully monitored. Concerning research involving developments using cell phones is the so -called "Interactive Manual implementation and integration to 3G cellular mobile network" [3] is a manual that summarizes techniques on methods of transmission in the UMTS technology, which displays data and measurements to be performed for RF communication.
At work "Dimensioning of a cellular system to a base station" [4], they developed a software engineering on the Matlab platform, to communicate a cell with a base station.

Another application which was used as a tool cell phone is the one made by Vergara Rojas, Ingha Isis [5], which is a system of a security field, which transmits the information to the interested user efficiently, via cell phone to remotely control multiple devices in the home (Domotica). In the development implemented by Herrera Huerfano Lilia Yolanda [6] where they performed an electrocardiogram implementation of which is monitored patient ECG signal and transmitted via cell phone to a computer that stores information. The main objective of this article is to transmit data in plain text from the collectors to a base station and response from the base station to the collector transmission system in a reliably and efficiently way.

Materials and methods

In developing the prototype for the communication made, we used the following main materials: the manifold, instrument by which survey data are taken, a communication card which is done by a PIC, which receives and sends serial data, two cell phones that communicate via text messages between them and the other instruments which are connected with a serial communication, and a computer, which performs the data storage classifying them as appropriate.

Main materials

The materials used in the implementation were: a computer, two cells with serial communication, a PIC 16F877 and manifolds, which are the main subject of the investigation.

Manifold

Figure 1. Manifold
Source: [7]

It is the tool that takes and collects field data for later transmission, which is the subject of this investigation. See Figure 1. Manifold.

PIC 16F877

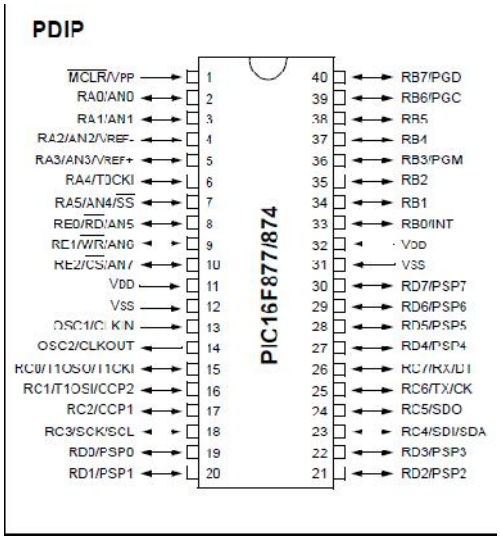

Figure 2. PIC 16F877
Source: [8]

It is a Microchip belonging to the family of 8 - bit microcontrollers, handling characteristics that identify from other families:

- Harvard architecture
- RISC technology
- CMOS technology

With these features highly efficient element is achieved in the use of the data memory and program, and therefore the operating speed. It also has implemented the RS232 protocol, which is essential for connecting the device to the collector and cell requirement. See Figure 2. PIC 16F877

Cell phone

Figure 3. Cell A56
Source: Authors

There are many types, brands, shapes, etc. of cells; in this case the Siemens A56 was used as shown in Figure 3, cell A56, because serial communication needed to control the same via AT command. He also handles messaging SMS (Short Message Service) text, it has Network frequency Dual band GSM 850 and 1900 MHz, which means you can use any of the mobile operators do have service in the country, which is an advantage, because this product is to be used in rural areas hence the mobile service have better service coverage. By using this cell phone is seeking to reduce space, cost and weight, the cell (Figure 3) has the following characteristics:

- Weight, 84 g
- Volume, 75 cm³
- Dimensions, (LxWxH) 103 x 46 x 21.5 mm

The cell model that is being used has a PDU (Protocol Data Unit) defined, for this reason it is needed the interface to perform reformatting. It has a cell for transmitting and receiving data as on the side of the manifold as on the side of the computer. The cell that is connected to the computer makes the receipt of data and downloaded the information directly to the computer.

Computer

Meets to receive the downloading text messages and stores them by cell phone number and then by date and time, through a user - friendly programming that developed in the Visual C # platform. For the computer can supply the need it must have a Microsoft Windows XP or Vista, with specifications ADM Turion ™ 64X2 TL-60, 2.00 GHz, 3.18 GB of RAM.

Method Development

The implementation turns around the programming done in C language, because it is more practical and work more comfortably in the program PIC C COMPILER. In contex , they have the following sequence, Figure 4 refers to the data transmission and Figure 5 shows the reception.

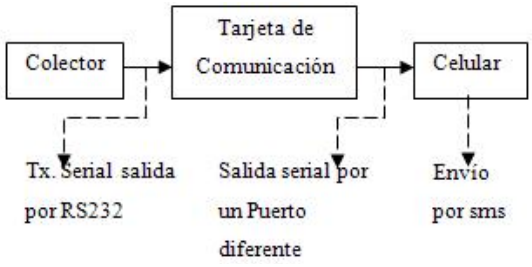

Figure 4. Transmission

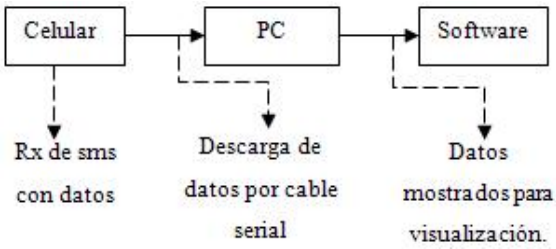

Figure 5. Reception
Source: Authors

Transmission

In Figure 4 it is shown in a block diagram how is the communication from the collector to the first cell. Each element and methods used for the transmission of information is described.

Manifold

The manifold has a serial port, which allows downloading data to any device that also counts with this connection. For doing the download, is necessary to do connection with the communication card, so you can transmit data to the base station. Downloading data that makes the collector, is done in plain text, this facilitates programming the microcontroller used in the communication card.

Communication Card

For communication between the manifold and the cell an interface which is composed mainly by the PIC 16F877 was performed, this device allows reception and transmission of data, because it has a USART module for serial communication. The communication board also has a connection of a MAX 232, which is an integrated circuit that makes the conversion of RS 232 signals suitable for digital logic signal. This converter is needed because the collector and the cell have RS 232 connection. As has already been said collector sends data in plain text, but the phone Siemens A56 manages its Data Units Protocol (PDU), for this reason a subroutine is develop, which performs data conversion flat text to the PDU to perform the data sent via text messages.

Programming for the card starts with serial data downloaded from the collector, they are stored in a memory in the PIC, then converting the data to PDU is done, when you have this conversion, the programming is done with AT commands (Advanced Technology), which are commands that are used to send data to the cell, the command that was used for the cell store data that is being sent as a text message was + CMGW, after this message on the cell transmission, which stores it in memory by the command + CMGW, sending the message to the cell that is part of the reception, this sent also performed automatically by the programming was done with the + CMGS command and when sender is deleted from the memory for this operation command + CMGD. See Figure 6.

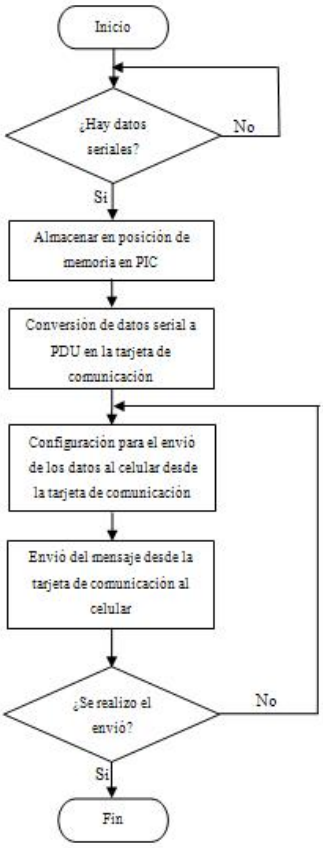

Figure 6. Communication Card
Source: Authors

The format of the PDU is required for sending and receiving text messages, to reach this conversion you need to follow several steps, first must verify that there is data in plain text, but after this the character data be broken down by character and move from ASCII data in hexadecimal format to convert after binary format, where each character will in septets, after conversion to binary the septet will change to octet, but in a specific order data left were taken to right where the first thing will be to initiate change this is done as follows: the bit last second septet is taken and placed in the first position of the first septet to leave this first 8 bits to convert the second septet, now is 6 bits, will be the same process only the third septet be caught

and he removed the last 2 bits to place them in the early part of the second septet, and so the conversion will continue until the last character and the end of this each octet process will pick up and will become again hexadecimal format.

It is having already completed the conversion proceeds to form the PDU in a certain order as: first you have the length of SMSC or SMS sent center default on the phone, then has the type of PDU, then is given reference number of the SMS that can be 00 if you do not have a specific value, followed by the length of the target location can be 9 digits where it would be 09 then has the kind of direction in this case is a reference number or national location, this is followed by the destination number, where the digit positions are exchanged and can be filled, if necessary, with F so that the number of digits is one par value. Below is the protocol identifier, the coding scheme, the period of validity of the message, the number of septets the message and finally has the message in the last conversion in hexadecimal. To send is added AT commands and sending is done. See Figure 7.

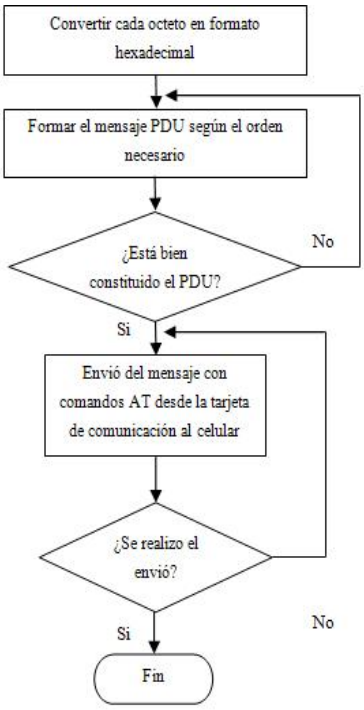

Figure 7. PDU Construction
Source: Authors

Cell phone

The cell used in the transmission, is connected to the communication card for serial connection to perform the download of data already converted into text messages, through programming as explained above. See Figure 8.

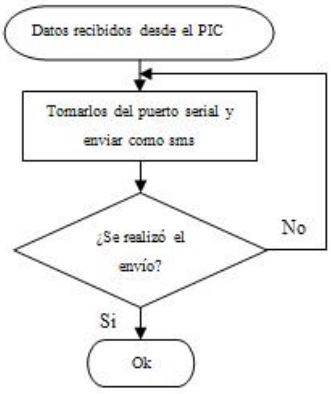

Figure 8. Cell
Source: Authors

Reception

The receipt of data is shown in the block diagram of Figure 5, shown here as the passage of information is from when it arrives in text message to the cell that is in the base station connected to the computer. In the following items clearly shown graphically and in writing the operation of each element used in this process of reception.

Cell phone

The cell used here is exactly the same cell that was used in the data transmission. In this communication process, the cell performs the reception of the text message that is downloaded by the application that was developed in the computer.

PC

The computer has the same serial connection that handles the manifold, for this reason a simply connection with the serial cable is done for the program that was designed with interface work friendly.

Software

For the reception of data is carried out in an orderly manner, is developing a program that lets you view in a friendly way, each of the messages by time and date of arrival, this program was made in the software Visual C #, as an opportunity to create a wide range of simple, effective and object - oriented applications.

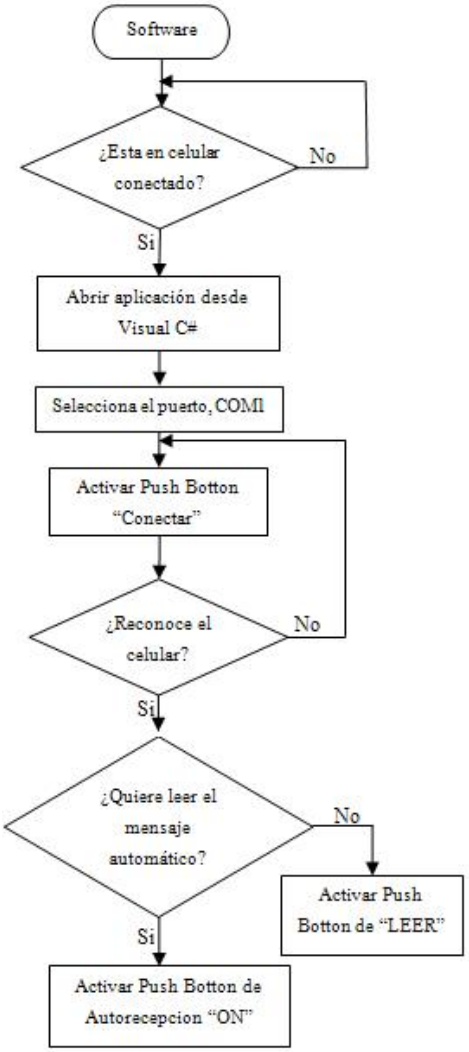

Figure 9. Software
Source: Authors

As shown in Figure 9 so that it can make downloading messages, you must connect the cell; otherwise, the application cannot run, then this is already connected to the computer via serial cable , the application will open and the port that will be downloaded text messages (COM1, COM2, COM3, etc, as appropriate), then the button labeled Connect is activated, this operation should be chosen the application recognizes the cell you are connecting to and identified with number, serial and brand of cell, at this point you have the option that the software you download messages

automatically or whenever the user wishes to download them, for this there are two buttons, to be automatically there is an option entitled auto receive and press to turn on or off as desired (see Figure 10) with the ON/OFF options, if this option is enabled, the system will update the messages received every 5 seconds, if this option is left OFF means you'll have to do manually each time you want to see new messages on cell must press the option READ (see Figure 12) in either of the two options, after the message is downloaded by the application on the cell phone, keep it in a notepad for each phone number to send messages, it will store by time and date of receipt, and immediately erased from the memory cell.

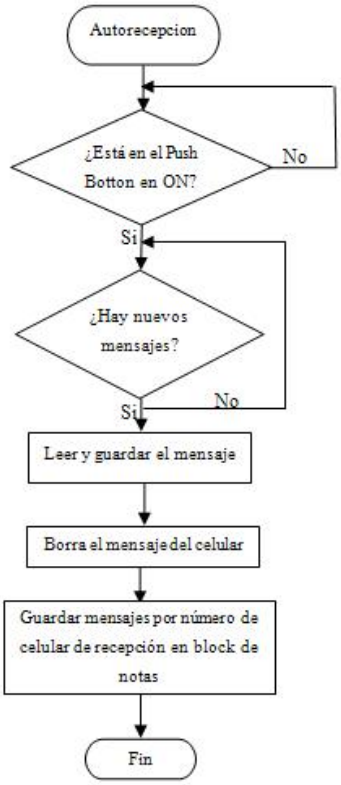

Figure 10. Autoreception
Source: Authors

In this programming download text messages, the same AT commands named above in explaining PDU were also used.

Figure 11. Application
Source: Authors

Figure 11 shown the interface that was developed for the reception of the data, this application also has the option of answering a cell writing down the number where the option that says RESPONSE and simply right or wrong button is pressed as appropriate or decided by the person who is manipulating.

Figure 12. Manual Reception
Source: Authors

Results

We performed the data sent from different phone numbers and different operators in order to define which is better suited to the needs that want to meet with development; the result will be shown by comparative tables.

301 295 51 xx		320 335 29 xx	
Transmission		Reception	
Hour	Coordinate	Hour	Coordinate
18:33:30	362589	18:33:32	362589
18:33:32	254,237	18:33:33	254,237
18:33:34	649,028	18:33:36	649,028
18:33:36	007,831	18:33:37	007,831
18:33:38	394,420	18:33:41	394,420
18:33:40	435,738	18:33:42	435,738
18:33:42	575,680	18:33:43	575,680
18:33:44	743,295	18:33:46	743,295

Figure 13. Chart Outcomes1
Source: Authors

The Figure 13 shows exactly the behavior of each of the messages sent, which are always stored in a notepad by the cell phone number that you are sending.

314 44 57 xx		320 335 29 xx	
Transmission		Reception	
Hour	Coordinate	Hour	Coordinate
10:20:14	845,758	10:20:15	845,758
10:20:16	235097	10:20:17	235097
10:20:18	038,457	10:20:18	038,457
10:20:20	490375	10:20:21	490375
10:20:22	895 798	10:20:23	895 798
10:20:24	603256	10:20:25	603256
10:20:26	378368	10:20:27	378368
10:20:28	314987	10:20:31	314987
10:20:30	890629	10:20:32	890629

Figure 14. Table of Results 2
Source: Authors

In Figure 14 it is evident how the handling of data between numbers of the same operator is.

318 867 25 xx		320 335 29 xx	
Transmission		Reception	
Hour	Coordinate	Hour	Coordinate
16:45:08	758 093	16:45:09	758 093
16:45:10	576,875	16:45:12	576,875
16:45:12	918,284	16:45:14	918,284
16:45:14	096,318	16:45:15	096,318
16:45:16	858,496	16:45:18	858,496
16:45:18	367599	16:45:22	367599
16:45:20	438,205	16:45:23	438,205
16:45:22	688,297	16:45:24	688,297

Figure 15. Table of Results 3
Source: Authors

In the ultimate test of sending data documentation is performed as shown in Figure 15, this test was performed with a cell of Movistar operator that is what makes the transmission and a cell of Comcel operator operates as a receiver.

Conclusions

It is not evident which of the cell phone service providers provides the best conditions for the transmission of messages, because if there is a failure the system automatically forwards the data until it is successful delivery, in other words the communication is reliable by the communication protocol proposed. The developed system has disadvantages, because it can only be used on sites that has mobile phone signal, if there is delay in delivery of more than one message the information would not be suitable for detailed tracking of the path having the surveyor, but also has some advantages among others that can vary the operator to be used both as in the reception as in the transmission, so just enough to know what moving company has coverage in the area.

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