Shared Radio System for Reclosers Control

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***Abstract*—Reclosers are typically used in the power electric plants to protect the system against temporary faults caused by natural effects (e.g., lightning, winds, trees) or permanent faults. Monitoring and controlling reclosers could be an expensive task depending on the type of reclosers are employed. A simple way to perform these tasks is by using radio communications capabilities.**

This paper describes a system to control a net of reclosers over a shared radio system. A main computer allows to monitoring all system status by a GIS (Geographical Information System) based software that facilitates the user operation.

I. Introduction

Generally, the power distribution system is protected by reclosers, which are compounded by a simple break and an electronic recloser relay interconnected. The purpose of recloser is reduce the fault time when a temporary problem occurs. The interrupts in the power electric source could be caused by natural phenomena such as: lightning, winds, trees or intentional faults like cars accidents, overloads, etc.

After the fault, the recloser must try reconnect the source and load again, timing according to its internal program. If a fault still present away, the recloser open and a new timing cycle starts again. The process repeats until the internal program counter (typically 3 times) finalizes the process and the recloser remains open until manual operation.

A recloser without communications capabilities could be a problem at this time, no alerts are sent to operators. Only the customers promote the signaling. The problem could be more complicate if a recloser is outside of the downtown. The time to reestablish the power should be long due to the distances.

A monitored recloser should be the efficient solution for this problem. The communications facilities are increased near to the cities but outside, the communications conditions are poor and expensive. A good solution is a radio-based system capable to coverage a large area with low costs.

A radio-based system described in this paper takes advantage of a shared radio-based system used to local communications on an electricity company that employ this monitoring system. The radio system is VHF Motorola compounded by personal radio unit, repeaters and vehicular units.

II. System Overview

The main block diagram that describes the system, in a general way, is shown in the Fig1.

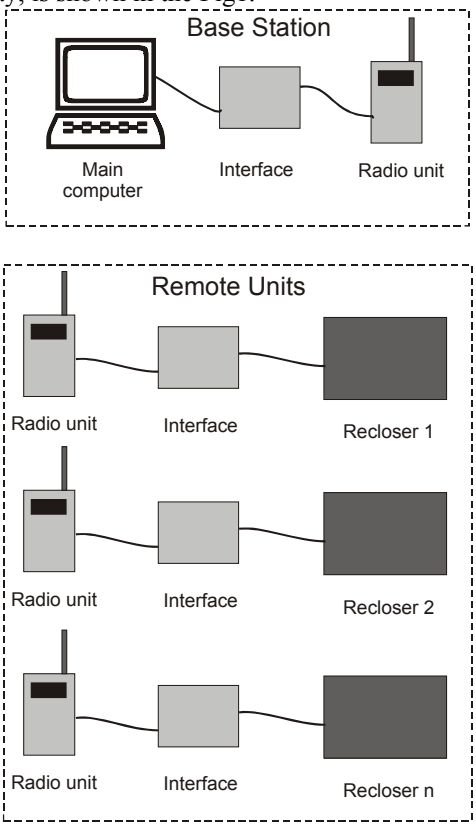

Fig.1 – Monitoring system based on radio control

The main computer is connected to the radio through an interface which control the data flux and capable to modulate and demodulate the signal from the radio unit.

The remote units are similar to the Base Station. In addition, the interface has additional circuitry, which provide a relay interface and digital inputs can be used in a wide range of applications.

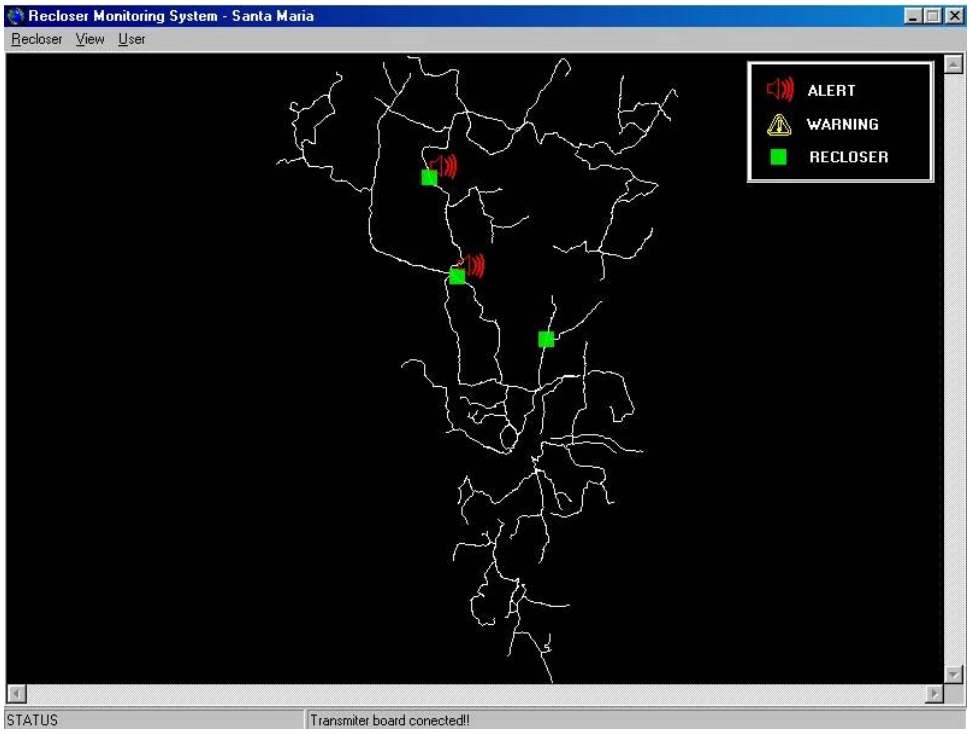

Fig.2 – The reclosers (square points) easily accessed by clicking in map.

III. The Base Station

The main purpose of the Base Station is to provide an easy access to the reclosers by the user. This stage is simplified with GIS based software designed on Windows system where the user can access the recloser directly by clicking in the map, which represents the electric plant of the system. The aspect of the program is shown in Fig. 2.

The interface between the radio unit and the computer takes the control of data flux and modem features. The internal block diagram is shown in Fig.3

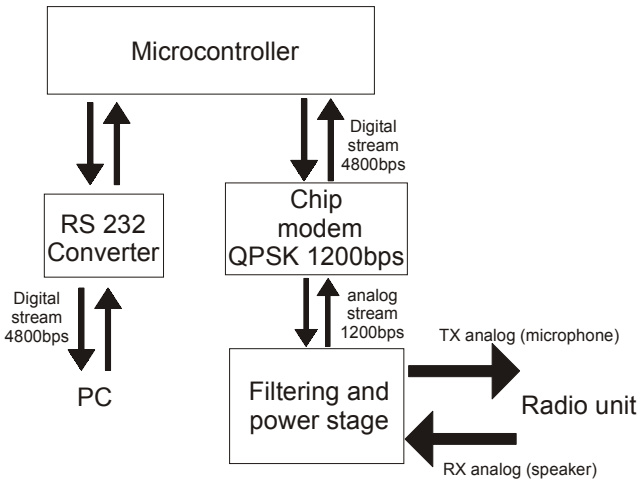

Fig. 3 – Interface block diagram

The microcontroller perform the full control on data flux such as: buffering data and handling errors messages, when the remote unit does not response. In addition, CRC16 check and on line current logging for all reclosers are implemented too. The microcontroller PIC 16F876 was employed to perform these operations.

The chip modem (TDK 73K222AL) works like a modem in QPSK (quadrature phase shift keying) running over 1200 bps with two streams frequencies. The highest channel transfer information from Base Station to Remote Unit and the lowest channel receives data from Remote Unit.

Basically, all data frames received from the computer are verified for validity using CRC16. A validated frame goes ahead through the chip modem to radio using the microphone plug. When a data is received from radio, it should be noticed a true data is consider only when a carrier is detect too, the microcontroller verifies the CRC16 and forwarded the frame to the computer.

Each quarter of hour, the microcontroller stars sweep all reclosers. The recloser should attempt this data solicitation. If it is not occur, an error message is sent to the computer and a new icon appears overlayed matching the recloser on the map. The correct response from the recloser is sent to computer in order to compose an on line current logging graphics. A typical current logging graphics is shown in Fig. 4.

Sometimes, the radio channel is busy and the user tries to

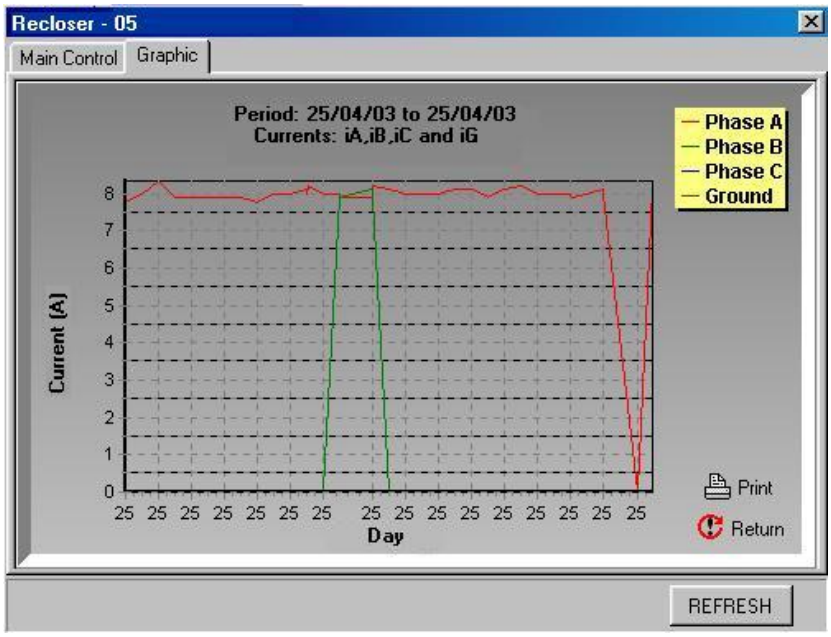

Fig. 4 – The on line currents logging.

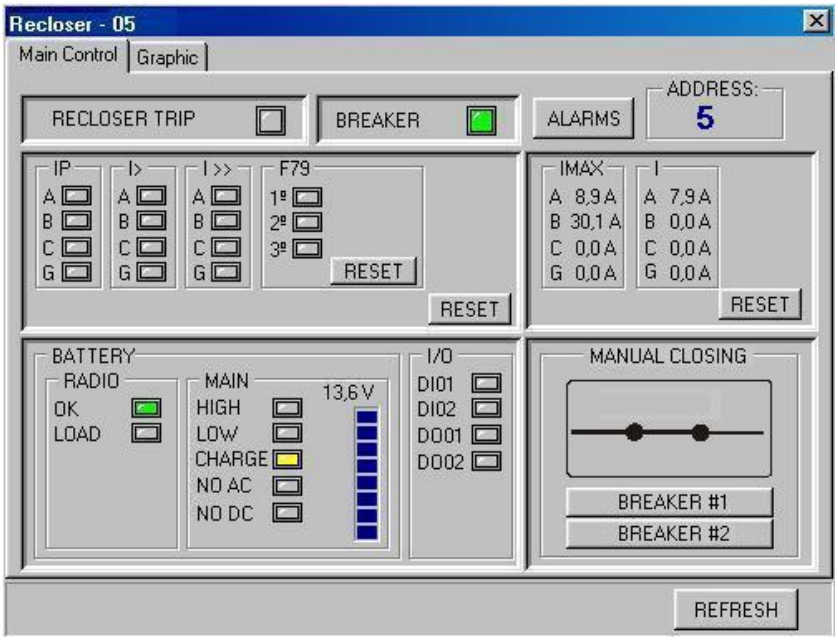

Fig. 5 – The main control recloser window.

communicate to the recloser. In this situation, the recloser should be not answer then the interface, in the Base Station, automatically resend the message frame up to four times, after, the error message are sent to the computer.

The main control recloser window is presented in the Fig.5

IV. The Remote Unit

The Remote Unit is designed to operate alone or connected with an electronic recloser relay when a complex remote control is needed. In the first case, the interface allows simple command such as remote reclose by user without electrical measurement, just digitals inputs can be observed.

A more complex application can be done by using an electronic recloser relay connected to the breaker. The block diagram, to exemplify this application, is shown in Fig. 6.

The interface controls the flux data between the electronic relay. In addition, some commands, using output relays, can be performed directly by the interface, like

reclosing. Others electrical measures should be get if available in the electronic recloser relay.

As shown in Fig.7, the block diagram of the interface in the Remote Unit is similar to the interface in the Base Station, except for the Digital I/O features and RS485 capabilities.

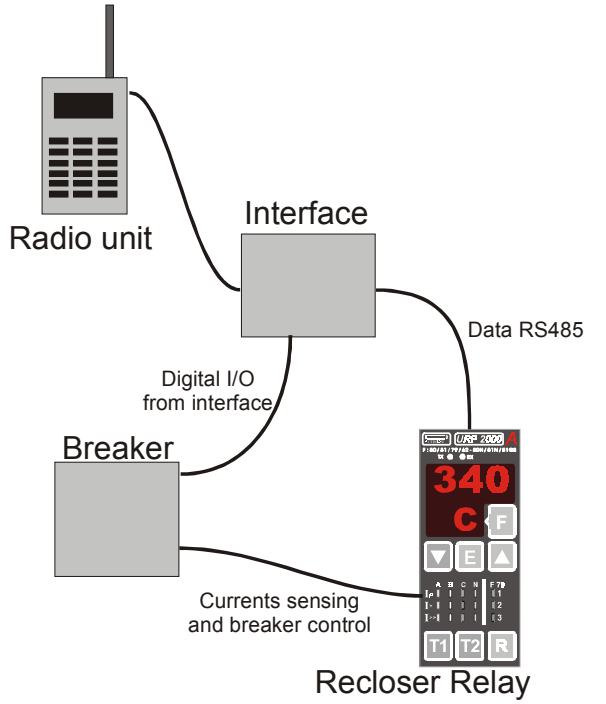

Fig.6 – The Remote Unit block diagram.

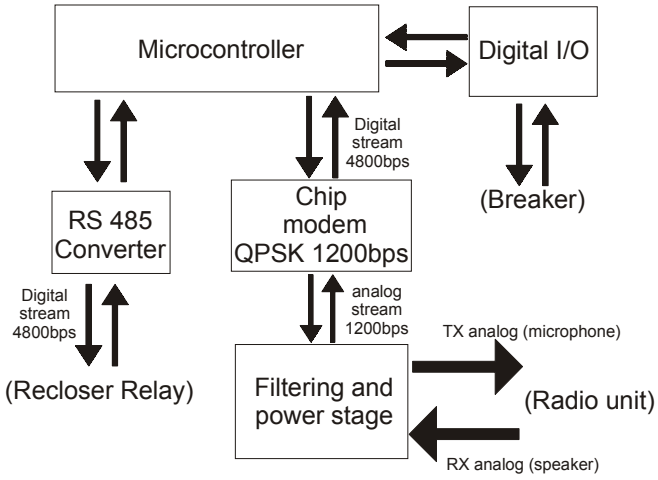

Fig.7 – Details of interface

Since receiving a message, the interface demodulates and checks the integrity by CRC16. The validate frame is decoded and performed according to the following rules:

1 - The frame destination is to the electronic relay.
2 - A command must be executed by interface.

At the case 1, the interface waits a response from the electronic recloser relay, when it is done, the received frame is sent to Base Station.

In the second case, using its I/O features, the interface performs the command that can be associated to a digital input or a relay output command.

Should be noticed, each frame in the system has identification, an electronic address, provided by the interface in the Remote Unit. Thus, the Base Station recognizes the frames from different Remote Units and the data are correctly handled in the main computer.

A recloser used in the implemented system is shown in Fig.8.

Fig.8 – A recloser implemented

V. Conclusion

This paper presented a system designed to control reclosers in a shared radio system. The system was based on a low cost microcontroller from Microchip and a chip modem provided by TDK. The reclosers applied should be easily changed to no autonomous breaks and more features could be added in the system like remote electric measurements. The GIS software interface facilitated the user operation by a graphic feedback. The implemented system has been presented a good performance in the control and monitoring of Santa Maria Power and Light Company.

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