MONITORING OF SUBSTATION USING RF BASED DAS IN ELECTRICAL DISTRIBUTION NETWORK

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Abstract:

With uninterruptedly growing of loads on power systems and incessantly altering loads on distribution transformer will interrupt the performance of total power systems. So it is essential to monitor the relentlessly varying loads on to inhibit the transformer from burning. The main aim is to use the RF technology to incessantly monitor and control the transformer from blazing due to the overburden which raises temperature and diminishes the insulation strength with high voltages. Usually maximum transformers are blazing because of overburden; henceforth it is imperative to incorporate the monitoring and control circuits, harmoniously increasing the lifespan of the transformer. Through RF technology it is possible to transmit the substation measured or acquired data over wide area to control room where control action takes place, with no loss of data within less time. This wireless transmission evolves the substation with less complexity over other communication protocols. WAMS process includes three different interconnected sub-process: data acquisition, data transmitting and data processing. Efficiency of the DAS can be improved with application of high resolution ADC and by using proper digital filters. WAMS plays an important role in modern automation of substation protection.

Keywords: DAS, WAMS, WAMPCS, Wireless Transmission, RF technology, LCD, Protocol.

I. Introduction

In the last two decades, power sectors have been liberalized, modernized and reorganized inorder to raise their efficiency, to reduce their effective cost and to permute the consumers from their selections of electricity suppliers. The effect of these variations, in association with the conventional power systems, innovative economic power industries face precise encounters that are allied to their generation, operation and planning. As a concern of these challenges, new systems should be hosted and recognized in the power systems in order to tackle such challenges. Wide area monitoring and control system is the one which is commercially available in power systems for the tenacity of monitoring and control.

In this paper we designed a system in such a way that it will observes the load of the substation endlessly and that information is transferred to the control room. In the control room these parameters are displayed on the LCD. In the control room it displays that continuous information of transformer that isowing to what entity the transformer has failed, when the power is resumed etc., with the help of this system, the conservation staff of the unit can have a
continuous vigilance over the transformer. Communication channel between substation and control room should possess less complexity circuits, fast operation with more accurate.

II. Sensors in DAS

The complete data acquisition system operation is starts from sensor measurements. Selection of sensors plays an important role in design of data acquisition system. For monitoring of transformer from variation of load and internal faults in transformer one should choose the three basic measuring sensors that is voltage, current and temperature. These sensors should work with maximum efficiency so that the data obtained by the DAS also is accurate. Voltage sensor collects the voltage of transformer and which mainly for avoiding the insulation faults. The current sensor is used for measuring the current from normal and overload and short circuit faults and temperature sensor which is most important in transformer protection for any violation of transformer parameter causes temperature increases. All these variations with loads and any faults should continuously monitor to maintain the transformer long life with high efficiency.

III. DAS in Substation

The information of voltage, current and temperature are deliberately observed through the corresponding sensors.

The obtained data from the sensors are converted into digital values by appropriate ADC, which are fed through microcontroller as shown in fig. 1. In microcontroller we are programmed such that if any exceeding of voltage, current and temperature in certain limit, then it gives an alarm and it shows a respective value deviation indication in the control room. To send this monitored data to control room circuit uses RF transmission, for this it adds encoder and RF transmitter as shown in fig. 1. To operate these all operation at a desired level, it requires a proper power supply.

IV. Receiving (Control) Section

In the control section simply RF receiver, encoder, microcontroller and LCD as shown in fig. 2. The monitored values that are sent by substation are obtained by RF receiver and this one is handled and controlled by microcontroller and it will display on LCD.
The supervised data can be sent via RF technology with this protocol the remoteness in substation and control room can keep widely. Compare to wired Data Acquisition system wireless DAS has more advantages. It reduces wiring complexity and which is less expensive.

V. Power Supply Circuit

![Power Supply Circuit](image)

Fig. 3 Power Supply Circuit

Supply required constant DC power supply as shown in fig. 3. From supply transformer voltage is stepped down to appropriate voltage from step down transformer and it is converted into DC by diode bridge circuit, which gives unidirectional voltage having ripples. With the application of filters, continuous DC is achieved regulators which maintains constant voltage which is essential to microcontroller and relay circuits.

VI. Data flow

Data flow from measured data to the data received in the control room is shown in fig. 4. The flow starts with initializing reference parameters, the real-time parameters are always measured and compared with reference values. If the parameters are within the limits the system in stable operation otherwise it gives the alarm. Give start command to ADC to convert analog signal to a digital value to process and control the data in microcontroller. The digital data are attained if the DRDY pin of the ADC is low, otherwise the process waits for checking any errors and starts from initial step. Using buffer, the digital data acquired from the ADC are stored after filling the buffer up to 10 samples reset the flag for the next count.

![Flow Chart for DAS Monitoring System](image)

Fig. 4 Flow Chart for DAS Monitoring System

After getting digital data from ADC fed it into microcontroller for the processing the data, like interpolate the data and decimation and increment the processor counter n times and rest the counter for the next count and clear the buffer and reset the full flag. This data flow is controlled and closely observes the watchdog from the various commands if there is no interlude it just start the loop from multiplexer otherwise its start again from initial conditions.

VII. Load Shedding

Based on the load demand, the substation should withstand at extreme and mild condition operations. Load shedding, mostly implemented when load...
overcomes the extreme conditions. Loads are continuously varying the boundary values of voltage, current and temperature should not more than normal operating conditions if it happens the transformer which feeds the loadsto customers may burn. So to shedding off the loads, program in Microcontroller will check the operating values at every instant and it checks the conditions like below:

If \( V_1 < V < V_2 \) operates at normal when \( V = V_2 \). If \( I > I_1 \) and \( T > T_1 \) are the conditions to detect abnormal conditions. Load shedding takes place when load is more than the supply as discussed above, where \( V_2 \) is threshold voltage setting for load shedding. Occurrence of above conditions means violations of normal conditions and the alarm rings for alerting the operators in the substations. Where \( V_1, V_2 \) are minimum and maximum voltage limits. \( I_1, T_1 \) are current and temperature limits respectively.

VIII. Results

The below figures shows the accuracy of the data acquisition system for different sensor inputs with corresponding channels.

![Fig. 5 Output Voltage Variation for input of 5mV](image)

![Fig. 6 Output Temperature Variations for input Temperature of 50 °C](image)

This system collects the continuous varying parameters and displayed in LCD. Under normal conditions the buzzer is in off position and the status of LCD display shows normal. The fig. 5 shows the variation of voltage output of DAS with supplying of input with 5mV. Current output variations about 20mA is shown in fig. 7 and temperature variations with input temperature of 50 °C is shown in fig. 6. The parameters with respect to change in load. Violation of these parameters at any loads and for faults gives the deviation indication in display and gives the alarm signals which is shown in fig. 8.

![Fig. 7 Output Current Variation for input Current of 20mA](image)
DAS for WAMS system has been developed for application in 11KV/415V distribution network. The system integrates the functions of sensing, collecting and monitoring of substation for monitoring the continuous load on the distribution transformer and fast grid supply restoration. Without control measures the system tripped off and lose supplies to all customers. Presently, with the applications of RF technology the transmit the data over 100m and the acquired data and transmitted data in this DAS has more efficient and reduces wiring complexity. A manual restoration process manually takes a long time (mins) to renovate power to all consumers. Therefore, with wide area protection and control system (WAMPCS) the renovation time can be reduced (Sec). In WAMPCS we can add features of the control and protection of the system along with the monitoring. DAS is the heart of the WAMPCS technology, and which supports the automation of the substation. With this the distribution network losses are reduced by considerably.

X. References


