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Wireless System Control Data Acquisition and Transmission System Design

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Abstract:-Today is the age of automation and centralized control of processes, where the emphasis is more and more towards coalescing of techniques to form a unified entity that can support itself without much intervention from external agents. With innovative and creative bent of mind, man comes out with solution for every problem. SCADA is a revolutionary development in automatic monitoring and control of processes that has replaced the classical methods of controlling the distribution systems, generation of electricity, customer information system, engineering analysis etc. It is observed that the complexities of large inter connected Power Systems has been simplified and the conventional methods of Power System operation are replaced by an user friendly Man - Machine interface. This has reduced the labor involved as well as the expenditure of operating the Power System by proper Energy Management System. . The advantages of the SCADA system has been very vividly highlighted which forces the modern Power Systems to opt for SCADA Automation eliminates human errors, while achieving better productivity and optimum utilization of resources with lesser requirement of time. SCADA is a revolutionary development in automatic monitoring and control of processes. SCADA's powerful tools are being increasingly used for centralized control of remote processes to optimize operation of really complex systems such as automation of energy distribution systems, generation of electricity, customer information system and engineering analysis.

Keywords: **SCADA (Supervisory Control and Data Acquisition), Microcontroller, Reset Logic.**

I. INTRODUCTION

In this project we are going to take different parameters at different stages like voltage, frequency, power, temperature etc. All the parameters are sensed through different sensors like Potential transformer, Current transformer, thermistor etc; converted into digital data through ADC, subsequently the data is read by the micro controller and transmitted to the pc for the process and data backup. The data backup is useful for future analysis, based on that the problems may be rectified; failure cases can be expected before undesirable situation is happen. After processing the pc gives a written control code to the micro controller the controller controls different devices based on code received from PC. For example: If the voltage exceeds the limits it gives an alarm and gives signal to the field excitation control to decrease the excitation. Like this the frequency, power, temperature can be controlled by using appropriate control parameters.

II. INTRODUCTION TO EMBEDDED SYSTEMS

Embedded System is a combination of hardware and software used to achieve a single specific task. An embedded system is a microcontroller-based, software driven, reliable, real-time control system, autonomous, or human or network interactive, operating on diverse physical variables and in diverse environments and sold into a competitive and cost conscious market. An embedded system is not a computer system that is used primarily for processing, not a software system on PC or UNIX, not a traditional business or scientific application. High-end embedded & lower end embedded systems. High-end embedded system - Generally 32, 64 Bit Controllers used with OS. Examples Personal Digital Assistant and Mobile phones etc .Lower end embedded systems

III. BLOCK DIAGRAM

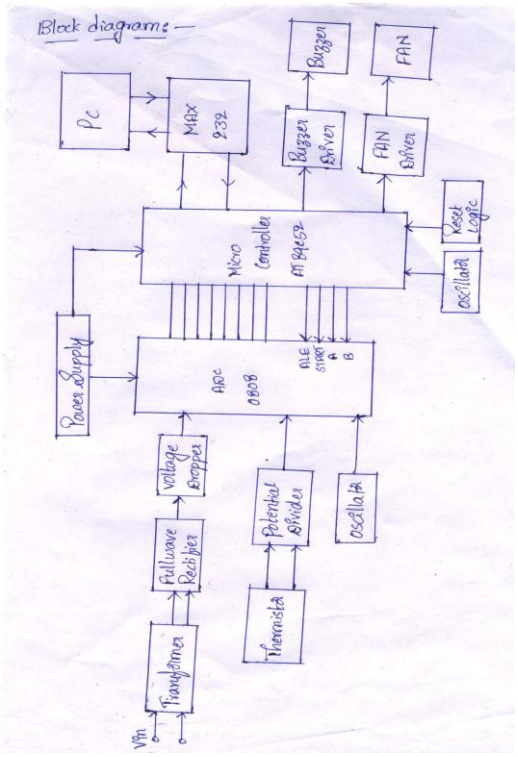

Fig 1. Block Diagram

A) Power Supply

The input a.c. supply is stepped down from 230V to 12-0-12V. The rectifier consists of diodes D1 and D2 makes the supply D.C. that is, unidirectional waveform. The output from rectifier is a URDC, whose value is 12.726V peak to peak. The voltage regulator makes this URDC to RDC of +5V. The capacitor C1 is used to maintain constant voltage between two consecutive positive cycles where as C2 is used to remove the fluctuations caused by regulator. Here we are selecting 12.726V as a peak value. Because of fluctuations, the peak voltage may decrease, then regulator

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cannot step up to +5V. If we select peak value, a higher one, then the problem can be overcome.

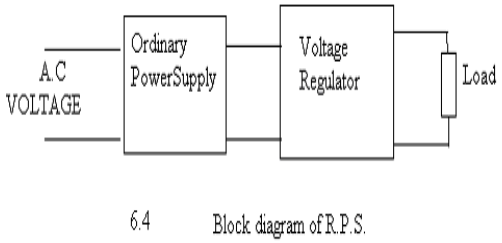

Fig 2. Block Diagram of RPS

A regulated power supply which maintains the output voltage constant irrespective of a.c. mains fluctuations or load variations is known as regulated power supply. A regulated power supply consists of an ordinary power supply and voltage regulating device. The output of ordinary power supply is fed to the voltage regulator which produces the final output. The output voltage remains constant whether the load current changes or there are fluctuations in the input ac. voltage. The rectifier converts the transformer secondary ac. voltage into pulsating voltage. The pulsating dc. Voltage is applied to the capacitor filter. This filter reduces the pulsations in the rectifier dc. Output voltage. Finally, it reduces the variations in the filtered output voltage

B) Need of RPS

In an ordinary power supply, the voltage regulation is poor i.e. dc. Output voltage changes with load current. Output voltage also changes due to variations in the input ac. voltage. This is due to the following reasons Controlling, this action is mainly performed by microcontroller, which is the heart of the project. The binary data received from the feedback is analyzed by the written program, and in case of any error it sends controlling signals to the relay, buzzer, and display sections. Display section consists of LCD screen which connected to microcontroller, in which the program is embedded to detect the fault location. The out put from the microcontroller decides the displaying characters in the display system, thereby displaying the fault location. The above block diagram gives the overall view layout of the project. The basic components used are microcontroller AT89C52, ADC0809, Instrumentation transformers, rectifiers, LCD, relay etc. here the microcontroller is 16-bit processing device .this project can be connected to the 33/11kv substation. but the practical model is implemented based on 230v.

C) Voltage Measurement

The voltage to be measured is taken from transmission line and it is stepped down to safe value by using potential transformer. The a.c output of the P.T is converted to d.c by full wave rectifier circuit. Then the output d.c is filtered and fed to voltage regulator to maintain constant voltage. The voltage regulator output is given to ADC in analog form which converts the analog data into 8-bit digital data on receiving the start of conversion signal from microcontroller. Here the ADC works based on successive approximation technique. The working voltage of ADC is 5v. The speed of the ADC is decided by oscillator frequency. The 8-bit digital equivalent of analog input of ADC is sent to the microcontroller which processes the digital data and displays it on the 16x2 matrix LCD display.

D) Data Acquisition

For future analysis the data will be stored in the PC. The LCD display only displays the amount of voltage and temperature. The PC will store the information about the parameters. It is not possible to transfer the information directly from microcontroller to PC. Because the Microcontroller uses TTL port and PC used RS 232 port. These two levels are not matched so level converter is used between the Microcontroller and PC. This level converter is MAX 232 C. The TTL signal output by a USART is not suitable for transmission over long distances, so these signals are converted to some other form to be transmitted.

E) Operation

The operation of the equipment mainly depends on the commands given to it from the control centre which is a personnel computer here. After connecting the equipment to the power supply the micro controller waits for the instruction from the operator through the computer. After receiving the instructions of operating limits of voltage and temperature the microcontroller reads the data and stores it in the registers .The values of voltage and temperature are sensed through the sensing devices- potential transformer and thermistor. These values are checked with the values in the registers continuously.

IV. UNDER NORMAL CONDITIONS:

The voltage and temperature are with in the operating limits; the micro controller continuously reads the data, displays it in the PC (control center) and saves the real time data in the data base for future references.

V. UNDER ABNORMAL CONDITIONS

When ever the voltage goes beyond the operating limits due to any faults on either source side or load side, then the controller raises the alarm and alerts the operator through an alert signal and trips the circuit with no time delay in order to protect the equipment with out operator intervention .This system gives two separate signals for abnormal conditions i.e., one for above the range and one for below the range set by the operator. Due to the variation of the atmospheric conditions, the temperature varies and the variation of temperature in power system is not appreciated even to a little extent in order to protect the system from collapsing .If the temperature of the equipment beyond the operating range the microcontroller automatically drives the fan to limit the temperature. Then the temperature become to its original state. All the

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variations of voltage and temperature during these conditions also monitored and displayed in the computer to give information to the operator about the situation occurred. For future analysis the information regarding to the parameters voltage and temperature are stored in the computer.

VI. SCHEMATIC DIAGRAM

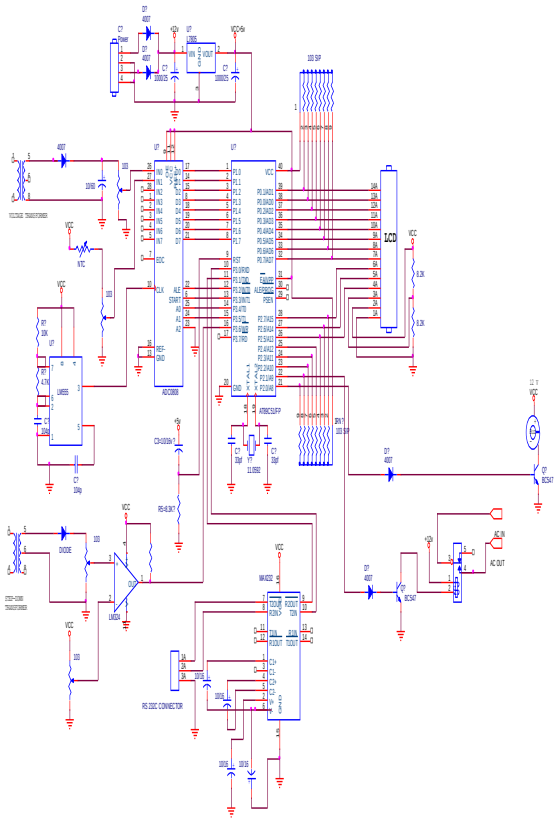

Fig 3. Schematic Diagram

A) Data Acquisition

The primary function of SCADA system is to automatically collect data from the field using various types of sensors. The data is acquired by means of Current Transformers, Potential Transformers, Transducers and various other methods.

There are two basic modes of capture of input data. These are:

- Scheduled Capture, whereby the local units are polled on a regular basis and all input data are transferred.
- Change of state capture, whereby only input data which have changed are transferred.

B) Supervisory Control and Monitoring

One of the main functions of SCADA system is to allow the entire process to be monitored and controlled with graphical user interface. The operator can interact and supervise a process from the operator console. The continuous monitoring can also ensure that the system retains its smooth operation by taking protective action. It is up to the individual specifications set, that decides how much the SCADA controls and monitors.

C) Alarms

All the data scanned by the Central monitoring station is processed so that the system detects the abnormal conditions and if present alerts the operator in the form of audio-visual indication thereby calling for the intervention.

D) Information Storage and Reports

Record-keeping has always been an important task in the operation of electric systems. Accurate records are necessary to satisfy legal and governmental requirements, for accounting purpose, for support and forecasting of future system operations, and for engineering planning purposes.

E) Data Processing

Data Processing means a conversion of data from raw form into the form that is useful for calculation and presentation. Data Processing is responsible for converting Analog values from raw data to engineering units. It is also responsible for converting digital status points to a system convention of device states (0-closed, 1-open).

F) Security Analysis

The system security of any process may be defined as the ability of the system to operate in normal state even with the occurrence of specified contingencies. System security analysis is generally broken down into following three functions:

- *System monitoring*: SCADA provides up to date information regarding the condition of the process.
- *Contingency analysis*: Sometimes abnormalities give the operator very less time to react. SCADA system provides contingency analysis, which consists of actions to be taken by the operator in advance. Thus it allows the system to operate defensively.
- *Corrective action analysis*: It allows the operator to take appropriate operating action in the event of contingency in order to ensure the smooth functioning of the process.

Features of SCADA are…

- SIMULATION OPTION
- DATA IMPORT/EXPORT OPTION
- FLEXIBILITY
- FORECASTING
- JOB MANAGEMENT

G) Thermister

Thermal sensitive resistors (thermistors) are commonly used types of temperature sensors. These types are essentially resistors which change value with a change in

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temperature. Thermistors consist of semiconductor material whose resistance decreases nonlinearly with temperature. Devices with 25degree resistance of tens of ohms to millions of ohms are available foe different applications. Thermistors are relatively inexpensive, have very fast response times, and are useful in applications where precise measurement is not required. These are used to produce a voltage proportional to the resistance of the thermistor.

H) Buzzer Driver

A buzzer or beeper is a signaling device, usually electronic, typically used in automobiles. Now-a-days, it is more popular to use a ceramic-based piezo-electric sounder like a Sonalert which makes a high-pitched tone. Usually these were hooked up to driver" circuits which varied the pitch of the sound or pulsed the sound on and off. The buzzer ON and OFF is controlled by the switching transistors (BC547). The buzzer is connected in the transistor collector terminal. When high pulse signal is given to base of the transistors, the transistors is conducting buzzer is energized and produces sound. When low pulse is given to base of transistor the transistor is turned OFF, and no current flows through the buzzer and buzzer is in off state.

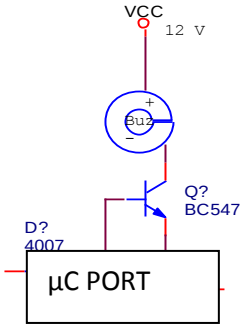

Fig 4. Buzzer Driver

I) RELAY OR ELECTRO-MECHANICAL SWITCH

It is a mechanical switch which is operated electrically to turn ON or OFF current in an electrical switch. Some of the advantages by using relays are

1. The relay requires a small power for its operation. This permits to control a large power in the load by a small power to the relay circuit. Thus a relay acts as a power amplifier i.e. it combines control with power amplification.

2. The switch in the relay coil carries a small current as compared to the load current. This permits the use of a smaller switch in the relay coil circuit.

3. The operator can turn ON or OFF power to a load even from a distance. This is a very important advantage when high voltages are to be handled.

4. There is no danger sparking as the turning ON or OFF is carried by the relay coil switch which carries a small current. But the speed operation is very small

J) RESET LOGIC

In this reset logic we have connected a 10 Microfarad capacitor and 8.2k resistor series network to the pin No.9 of Micro Controller that provides active high RST signal to the Micro Controller. At the time t =0sec the capacitor acts as a short circuit, due to that 5V is applied at RST pin. Slowly it comes to 0V after complete charge of capacitor. After reset the Micro Controller's program counter selects 000H of internal flash.

K) Voltage Regulator

The Digi-lab board can use any power supply that creates a DC voltage between 6 and 12 volts. A 5V voltage regulator (7805) is used to ensure that no more than 5V is delivered to the Digi lab board regardless of the voltage present at the J12 connector (provided that voltage is less than 12VDC). The regulator functions by using a diode to clamp the output voltage at 5VDC regardless of the input voltage - excess voltage is converted to heat and dissipated through the body of the regulator. If a DC supply of greater than 12V is used, excessive heat will be generated, and the board may be damaged. If a DC supply of less than 5V is used, insufficient voltage will be present at the regulators output. If a power supply provides a voltage higher than 7 or 8 volts, the regulator must dissipate significant heat. The "fin" on the regulator body (the side that protrudes upward beyond the main body of the part) helps to dissipate excess heat more efficiently. If the board requires higher currents (due to the use of peripheral devices or larger breadboard circuits), then the regulator may need to dissipate more heat. In this case, the regulator can be secured to the circuit board by fastening it with a screw and nut (see below). By securing the regulator tightly to the circuit board, excess heat can be passed to the board and then radiated away.

VI. CONCLUSION

In this way without much human effort, by using SCADA system we can monitor the generating unit in a power plant and can control the performance automatically. The data stored in the database is used for the further studies like load flow analysis, fault studies, future extension, expansion of the existing power system. This project can be extended to control each and every parameter of the power system as well as every process in the operation of power system. Thus we can monitor and control the entire power system automatically

VI. KIT DIAGRAM

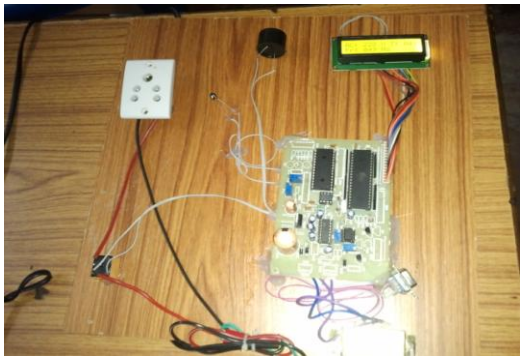

Fig 5. Kit

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