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Efficient Power Distribution with Monitoring and Control using Arduino

K.R.Parthasarathy[1] ,T.Senthil[2], Soma Sekar S[3], VignesNandhaBharathy.M.J[4], Sudharsan.K[5]

[1] Senior Engineer, Controls & Instrumentation/FB, BharathHeavy Electricals Limited
[2]Senior Assistant Professor, Electronics and Communication Engineering, Kalasalingam University.
[3]Student, B-Tech Electronics and Communication Engineering, Kalasalingam University.
[4]Student, B-Tech Electronics and Communication Engineering, Kalasalingam University.
[5]Student, B-Tech Electronics and Communication Engineering, Kalasalingam University.

***Abstract*—Electrical distribution system depends mainly on efficient working of transformer. Monitoring the working condition of transformer all the time is a tedious process.Problem at any part of distribution network due to overloading may take human intervention. To maintain the stable operating condition we suggest remote monitoring of transformer along with prevention of attaining previous overload values.Using ARDUINO microcontroller with sensor setups we collect the status of temperature&vibrations of transformer and display the data in LCD monitor is primary process. Power sharing is activated with secondary transformer by microcontroller using preconfigured load power values. User interface is achieved withwired Profibus communication to access and alter the power (voltage& current) values from monitor station.The proposed system of power distribution system monitoring and controlling will prevent frequent overload problem and also limits periodical human inspections.**

***Keywords*-- Transformer, ARDUINO microcontroller, LCD, Overload problem.**

1. INTRODUCTION

Electrical energy is the prime source of today's world. The demand for electricity increases day by day in a drastic manner. This increased consumption not only increases electricity production but also its distribution networks. The vast network consistsof Transformerswith different power ratings, used to distribute the load effectively. Occurrence of over load condition is quiet often happening. Thistype of problematic situations burnout transformers and causing extensive damages to current transformer, potential transformer, and protective relays[1] etc, if not properly monitored. To reduce such occurrence of overload problems in load side and in distribution side, continuous monitoring of distribution transformers is necessary. This situation can be prevented bymaintaining frequent inspection of transformer. This seems to be efficient, but determining the fault before its occurrence makes the situation ridiculous. Hence to solve this problem, effective monitoring of distribution lines using ARDUINO microcontroller is made. Along with this, temperature and vibration value of distribution transformer [3] are sensed and sent to controller. These values are compared with reference values to kick start sharing of overload, if input value exceeds the reference. User interface is achieved with the help of PROFIBUS communication between controller and user so as to adjust the reference values according to the power requirement in the distribution lines.

II.EXISTING SYSTEM.

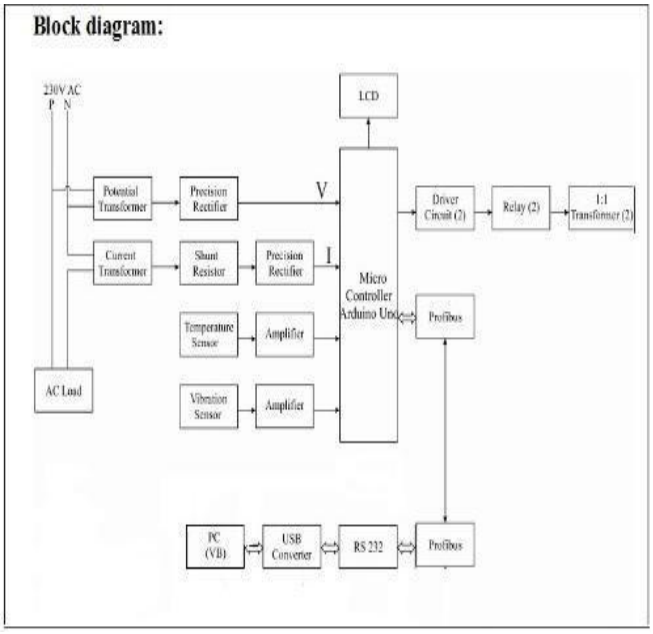
Various safety measures are available for distribution station transformer, in electrical substations. If any transformer goes beyond peak operational value, the control station disconnects the particular transformer[4] from grid using breaker setups.Various technologies like supervisory control and data acquisition (SCADA), programmable logic controller (PLC) are used in protection and communication[5] purposes. One control centre is functioning with voice communication facility for all Sub Stations over radiofor continuous monitoring and control of transformer loads. Power line carrier communication (PLCC) used for voice and data communication because of repeater less communication over few hundred kilometres.In case of increased consumption, certain transformer capacity is to be increased. In that situation replacing the old one with new one may require huge investments. Commercial and industrial sectors usescheduling and diverting the load from peak period to off peak period (load shifting) to distribute the load uniformly. The drawbacks of the existing system are it need more human intervention and also uses complex closed loop strategy.

III.PROSEDSYSTEM.

To overcome the above drawbacks we are introducing simple and efficient control system using arduino for maintaining the power distribution system. Overloading problem in transformer can

be prevented than post accidental curing. To achieve in that way limiting power values for some certain saturated operational condition and to share the increased demand using additional transformer will be beneficial. This concept will help to maintain supply power during failure or overload condition of main transformer. Automation is achieved using ARDUINO microcontroller and PROFIBUS serial communication. Controller compares the reference value [10] with power values in load lines.If the value of current exceeds reference value the power sharing command sent to relay settings via driver circuit. PLC, SCADA, arereal-time applicable because of capabilities of handling increased current and voltage values. This also increases the transformer lifetime and by including constant monitoring of temperature & vibration conditions with the help of thermistor and piezoelectric sensors. Whenever the primary or main transformer gets breakdown due to overload condition or to be shut down for maintenance purposes, the power can still be maintained to load using secondary or additional transformer.

IV.WORKING PRINCIPLE OF OUR PROPOSED SYSTEM



The project consistsof supply transformer to step down the voltage to small level of 15v which is supplied to different internal units. Potential transformer and current transformers are used to read the voltage and current values from main load line. These transformer step down the values and they are processed by shunt resistor and precision rectifier setup. Shunt resistor used to drive the unnecessary voltage and half wave precision rectifier combines the operation of inverting and summing amplifier. These values are feed as DC input to thearduino microcontroller. The arduinocontroller is predefined with reference values of power and is compared with input values. The instantaneous input values are displayed in two line LCD display. When the input value exceeds the reference values, microcontroller sends the signal voltage to driver circuit which act as switching circuit for relay control.

After enabling driver circuit the relay gets energised and activates the second transformer to share the load with primary load transformer. Input for the sharing transformer comes from main power supply side and output is feed to the load side under monitor. These two transformers are with same power ratings. User can interface with the help of PC provided with profibusserial communication with microcontroller. The profibus communication has the ability to withstand inindustrial and noisy environment. The communication between the user of control station and the controller is about 9.6kbits/sec. Though function is done independently with the help [7] of reference values and commands from microcontroller but also the user can alter the reference value from control station. Temperature and vibrations are also taken from the transformer core and displayed in PC to estimate the safety level of working transformer.

V.HARDWARE DESCRIPTION

ARDUINO MICROCONTROLLER: The ATmega328P is a CMOS 8-bit microcontroller with low power input. It has reduced instruction set computer (RISC) architecture, which requires less time for instruction execution over complex instruction set computer (CISC). The main features of arduino atmega328p are it have 4K/8K bytes of In-SystemProgrammable Flash with having capabilities of Read-While-Write operation, 1K bytes EEPROM, 2K bytes SRAM, general purpose I/O lines counts to 23, general purpose working registers counts to 32,three flexible compare mode timers/counters, internal and external interrupts, a serial programmable universal synchronous asynchronous transmitter/receiver(USART), a 6-channel 10-bit ADC, aprogrammable Watchdog timer with internal Oscillator, and selectable power saving modes up to five softwares. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, USART, 2-wire Serial Interface, SPI port, and interrupt system to continue functioning. The register contents is saved by Power-down mode but freezes the Oscillator, all other chip functions are disabled until the next interrupt or reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while sleeping the rest of the device. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC, to minimize switching noise duringADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low power consumption.

PROFIBUS SERIAL COMMUNICATION: PROFIBUS serves as a open, vendor-independent protocol that became part of the international standard IEC 61158 in 2000.The protocol is mature, not static! Over time, it extends into new areasof application by working groups of employees from companies that have similar output products and target area of application. They developed this extension under the requirement of ensuring backwardcompatibility. The first

version of PROFIBUS is DPV0 and it also serves as a foundation developed from FMS. Further FMS is optimized to develop DPV0, the original PROFIBUS protocol, which support fast I/O data exchange. PROFIBUS DPV1 added extensions that allowed run-time reading/writing of parameters for more sophisticated devices such as intelligent drives. PROFIBUS PA field instruments, such as relay adjustments, pressure transmitters, step-up motors etc. In order to require a secondary motion-control bus, DPV2 added extensions primarily so that motion-control applications can be performed directly across PROFIBUS. PROFIBUS DP is a network has bus communication between two devices: master and slave devices. It is a bi-directional network, meaning that one device, from master, a request is sendto a slave, and the response to that request is obeyed by slave.Only one master can control the bus at any instant of time, and a slave device purpose is to respond immediately to a request sent from a master Thus, bus contention is not a problem. The PROFIBUS protocol supports addresses from 0 to 127. For special usage, addresses 126 and 127 may not be assigned to operational devices. Address value 0 becomes default address that the vendors assign to network configuration and/or programming tools attached to the bus. Thus, the addresses that may be used in practice for operational devices – for example, PLCs, I/O nodes, drives, encoders, and the like – arebetween 1 - 125.

TRANSFORMER: Different transformer ratings are used for input power supply. The main supply transformer step down 230v input to 0-9v (1.5A) and 15-0-15v (3A). The potential transformer step-down 230v to 0-9v. Currenttransformer ratings of 15 ampere are used in our project.

OTHER HARDWARE COMPONENTS: 2x16, two line LCD display having capacity of displaying 32 characters.15k shunt resistor for device safety and operational amplifier LM741 as inverting amplifier and diode IN4148 for rectification of input signals. Driver circuit using transistor BC547 and relay SPDT for providing sharing transformer's input supply.

VI.CIRCUIT DIAGRAM:

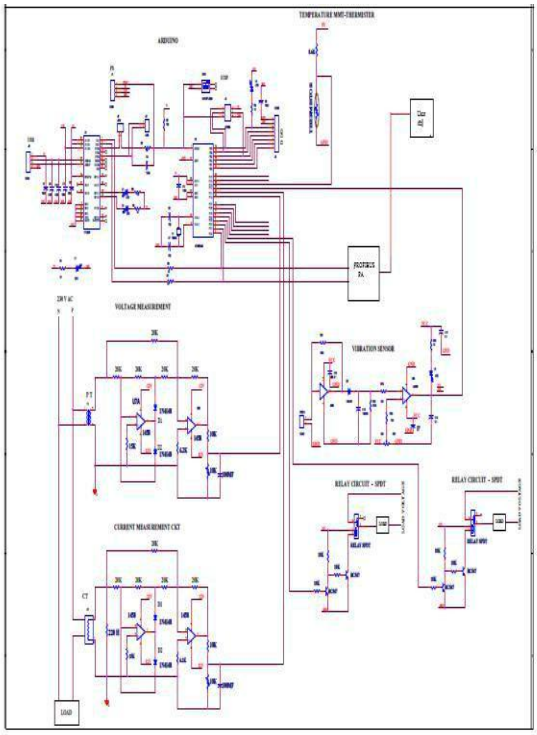


Fig.2. circuit diagram.

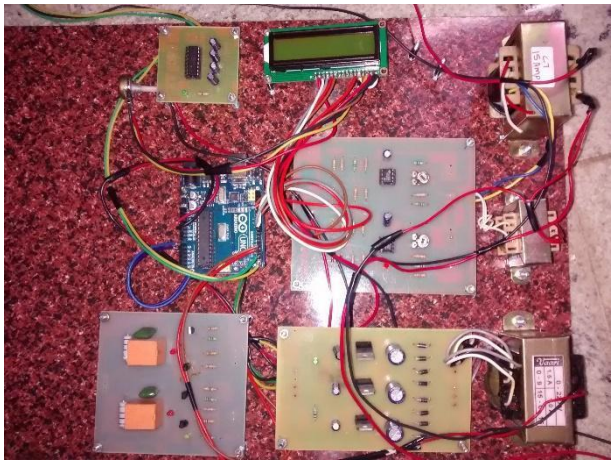


Fig.3. hardware arrangement.

V1.CONCLUSION

Energy efficient automation in power distribution will help to reduce and rectify the above mentioned problems in load distribution and sharing.Hence manual energy, fuel for travel, employee time will be preserved by the implementation of the above work. It also helps to increase life time of the transformers under application.

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